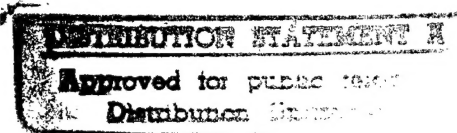


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# USSR Report

ELECTRONICS AND ELECTRICAL ENGINEERING

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# USSR REPORT

## ELECTRONICS AND ELECTRICAL ENGINEERING

### CONTENTS

#### AEROSPACE AND ELECTRONIC SYSTEMS

- Coherent Signal Conversion System Employed in  
Astronomical Centimeter-Band Super Long-Base  
Radio Interferometer Developed by Scientific-  
Research Radio Physics Institute  
(B. N. Lipatov, A. S. Sizov; IZVESTIYA  
VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA,  
No 2, Feb 84)..... 1
- Announcement of Upcoming Collection: 'Space-Time  
Signal Processing'  
(IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY:  
RADIOFIZIKA, No 2, Feb 84)..... 1
- Meter-Band Superlong-Base Radio Interferometer for  
Astrophysical Research  
(B. N. Lipatov, A. S. Sizov; IZVESTIYA VYSSHIKH  
UCHEBNYKH ZAVEDENIY: RADIOFIZIKA, No 2, Feb 84)..... 2
- Computerized Astronomical Television System  
(V. A. Kachmin, et al.; OPTIKO-MEKHANICHESKAYA  
PROMYSHLENNOST', No 4, Apr 84)..... 2

#### ANTENNAS AND PROPAGATION

- Very Low Frequency Fluctuations of Parameters of  
Earth-Ionosphere Waveguide  
(V. G. Bezrodnyy; IZVESTIYA VYSSHIKH UCHEBNYKH  
ZAVEDENIY: RADIOFIZIKA, No 2, Feb 84)..... 3
- Properties of Development and Relaxation of Artificial  
Ionospheric Perturbation: Experimental Results  
(V. A. Alebastrov, et al.; IZVESTIYA VYSSHIKH UCHEBNYKH  
ZAVEDENIY: RADIOFIZIKA, No 2, Feb 84)..... 3

Influence of Curvature of Phase Fronts of Powerful and Probe Waves on the Scattering by Artificial Periodic Lattice (V. G. Lapin, V. V. Tamoykin; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 2, Feb 84).....	4
Diffraction Propagation of Centimeter Waves (P. N. Dagurov, et al.; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 2, Feb 84).....	4
Backscattering of Waves by Two-Scale Uneven Surface With Allowance Made for Multiple Reflections (V. U. Zavorotnyy; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 2, Feb 84).....	5
Allowance for Symmetry of Cylindrical Reflector in Numerical Solution of Diffraction Problem (D. D. Dobrovol'skiy, V. A. Il'ichev; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 2, Feb 84).....	5
Allowance for Correlation Between Medium and Source in Describing Radiation From Random Sources in Scattering Medium (L. Apresyan; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 2, Feb 84).....	6
Spatial Correlation of Very Low Frequency Radio Signals in Multimode Ground-Ionosphere Waveguide (V. G. Bezrodnny; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 3, Mar 84).....	6
Scattering of Narrow Wave Beam on Random Irregular Surface in Atmosphere (M. L. Belov, V. M. Orlov; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 3, Mar 84).....	7
Electromagnetic Wave Spectrum in Turbulent Collision Plasma at Large Distance From Source (V. G. Gavrilenko, S. S. Petrov; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 3, Mar 84..	7
Resonant Interaction Between Beam Waves and Periodic Lattice of Conducting Planes (A. A. Bulgakov; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 3, Mar 84).....	8
Measurement of Polarization and Phase Patterns of Antennas and Amplitude-Phase Distribution by Correlation Method, Using Extraterrestrial Radiation Sources (N. V. Veksler, et al.; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 3, Mar 84).....	8

Equilibrium of Plasma Layer in High-Frequency Electromagnetic Field (L. M. Gorbunov, et al.; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 3, Mar 84).....	9
Scattering of Radio Waves in Long-Wave Portion of Millimeter Band by Snow (A. S. Zakharov, et al.; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 3, Mar 84).....	9
Use of Cumulant Function Method for Statistical Analysis of Dot Patterns (Yu. V. Koblyanskiy, V. N. Kurashov; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 3, Mar 84).....	9
Observation of Full Lunar Eclipse 9 January 1982 at 3.2 MM Wavelength Through RT-7.5 Radio Telescope of Moscow Higher Technical School (V. N. Ivanov, et al.; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 4, Apr 84).....	10
Instability at Ionic Gyrofrequency in Ionospheric F-Layer (A. Ye. Krupina; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 4, Apr 84).....	10
Scattering of Radio Waves by Quasi-Periodic Ionospheric Array Distorted by Natural Inhomogeneities (N. G. Denisov, V. G. Lapin; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 4, Apr 84).....	11
Approximate Methods of Solving Scalar Problem of Wave Scattering by Smoothly Nonhomogeneous Plasma Bodies (A. V. Moroz; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 4, Apr 84).....	12
Diffraction of Electromagnetic Waves by Rectangular Wedge Pair (G. I. Makarov, A. P. Sozonov; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 4, Apr 84).....	12
Two-Element 80-Meter Antenna (Vl. Goncharov, Vikt. Goncharov; RADIO, No 5, May 84).....	13

#### BROADCASTING/CONSUMER ELECTRONICS

Transverter Attachment for Elektronika-Kontur-80 Equipment (G. Kasminin; RADIO, No 1, Jan 84).....	14
--	----



Synchronization of Crosshatch Generators (I. Zelenin; RADIO, No 1, Jan 84).....	14
Improvement to Picture Tube Testing Device (K. Pish; RADIO, No 3, Mar 84).....	15
Optical Spatial Filtering of Photographic Sound Tracks in White Light (A. A. Lapidès; TEKHNKA KINO I TELEVIDENIYA, No 4, Apr 84).....	15
Phase Distortions in Magnetic Recording-Playback Channel (L. N. Popov, L. V. Shitov; TEKHNKA KINO I TELEVIDENIYA, No 4, Apr 84).....	15
Updated Nomenclature of Motion-Picture Light Filters (A. M. Kuritsyn, Ye. M. Shlyakhter; TEKHNKA KINO I TELEVIDENIYA, No 4, Apr 84).....	16
Use of Microprocessors in Transmitting TV Cameras (V. V. Bykov, et al.; TEKHNKA KINO I TELEVIDENIYA, No 4, Apr 84).....	16
Potential Efficiency of Differential Pulse-Code Modulation Television Broadcast Signals (N. G. Kharatishvili; TEKHNKA KINO I TELEVIDENIYA, No 4, Apr 84).....	17
Input Circuit of Device With Flat Screen for Representation of Television Information (B. V. Kazakov, A. A. Rysin; TEKHNKA KINO I TELEVIDENIYA, No 4, Apr 84).....	18
Measurement of Television Signal Frequency and Deviation (L. Ya. Shapiro; TEKHNKA KINO I TELEVIDENIYA, No 4, Apr 84).....	18
Formation of Viewing Zones of Point-Focusing Screens (A. V. Vorob'yev, et al.; TEKHNKA KINO I TELEVIDENIYA, No 4, Apr 84).....	19
CIRCUITS AND SYSTEMS	
Light Filter Selection Device (V. Maslovskiy, V. Shapoval; RADIO, No 1, Jan 84).....	20
Asynchronous-Reset Counters (V. Psurtsev; RADIO, No 1, Jan 84).....	20
Color Organ Employing Digital Signal Processing (V. Kovalev, A. Fedoseyev; RADIO, No 1, Jan 84).....	21

Digital-Analog Elements in Audio Frequency Channel (D. Luk'yanov; RADIO, No 1, Jan 84).....	21
Active Band-Elimination Filter With Electron Tuning (I. Nechayev; RADIO, No 1, Jan 84).....	21
Metal Detector (L. Bulgak, A. Stepanov; RADIO, No 1, Jan 84).....	22
Digital Frequency Indicator (M. Nazarov; RADIO, No 3, Mar 84).....	22
Parameters of Simplified Equivalent Circuit With Iron-Core Inductor for Operation in Pulse Mode (Valeriy Vladimirovich Yakovenko; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA, No 3, Mar 84).....	22
Design of Polymer Light Filters With Given Spectral Characteristics for Circular Polarizers (M. A. Tushishvili, et al.; OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST', No 4, Apr 84).....	23
Step Attenuator From Materials Sent to 'Radio-60' Competition (V. Skrypnik; RADIO, No 5, May 84).....	23
How to Reduce Noise Level in Audio-Frequency Channel (D. Atayev, V. Bolotnikov; RADIO, No 5, May 84).....	24

#### COMMUNICATIONS

Improving Efficiency of Long-Distance Telephone Communication (I. P. Maslenkova; VESTNIK SVYAZI, No 3, Mar 84).....	25
Improving Quality of Hookup Between Long-Distance and Local Telephone Exchanges (V. S. Lopareva; VESTNIK SVYAZI, No 3, Mar 84).....	25
Stages of a Modern Transceiver (V. Drozdov; RADIO, No 3, Mar 84).....	26

#### COMPONENTS, HYBRIDS AND MANUFACTURING TECHNOLOGY

Electrical Grades of Steel Produced in Poland for Magnetic Components of Series 'A1' Induction Motors (Zbigniew Matheisel; ELEKTROTEKHNIKA, No 11, Nov 83).....	27
--	----

Production of Modern Cable Manufacturing Equipment in CEMA Countries (I. M. Greblov; ELEKTROTEKHNIKA, No 11, Nov 83).....	28
High-Voltage (110/220 kV) Cables With Plastic Insulation (I. B. Peshkov, et al.; ELEKTROTEKHNIKA, No 11, Nov 83).....	28
Specialization in Manufacture of Extrusion Equipment Lines by 'Interelektro' Group 7 (G. Servanski; ELEKTROTEKHNIKA, No 11, Nov 83).....	29
'Interelektro' Involvement in Manufacture of Machine Tools (Yu. S. Kiryushin, et al.; ELEKTROTEKHNIKA, No 11, Nov 83).....	30
Electric Drives for Metal Cutting Machine Tools With Digital Program Control and for Industrial Robots (K. Stanilov, et al.; ELEKTROTEKHNIKA, No 11, Nov 83).....	30
Cooperative 'Interelektro' Development of Small Low-Voltage Cosine Capacitors (G. A. Bocharov, M. M. Morozov; ELEKTROTEKHNIKA, No 11, Nov 83).....	31
Standard Series of Automatic Circuit-Breakers (G. F. Mitskevich; ELEKTROTEKHNIKA, No 11, Nov 83).....	32
Standard Series of Luminaires (Yu. Ye. Novoselov, G. R. Shakhparunyants; ELEKTROTEKHNIKA, No 11, Nov 83).....	32
Trends in Development of High-Pressure Sodium Lamps (D. Vida, G. Balog; ELEKTROTEKHNIKA, No 11, Nov 83).....	33
New Economical Light Sources (A. M. Kokinov, Ye. I. Smakayev; ELEKTROTEKHNIKA, No 11, Nov 83).....	33
Interference Sensor of Position of Achromatic Band (V. K. Maslennikov, et al.; OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST', No 3, Mar 84).....	34
Improving Quality of Reflector Surfaces (R. A. Mikhnev, et al.; OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST', No 4, Apr 84).....	34
More Information on S1-94 Oscilloscope and Attachments for It (A. Bogdan; RADIO, No 5, May 84).....	35

High-Frequency Power Amplifier (Yu. Solntsev; RADIO, No 5, May 84).....	35
COMPUTERS	
Microcomputer Receives and Transmits Telegrams (A. V. Semenyutin; VESTNIK SVYAZI, No 3, Mar 84).....	36
CONTROL SYSTEMS	
'Recurrence' Criterion of Stability and Expansion Into Continued Fraction (Andrey Nikolayevich Lebedev; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA, No 3, Mar 84).....	37
Zeroes of Control Systems With Monitoring Devices (Anatoliy Romanovich Gayduk, Nikolay Mikhaylovich Lutskiv; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA, No 4, Apr 84).....	37
ELECTRICAL INSULATION	
Self-Recovery of Electric Strength by Metallized Dielectrics (L. G. Petrenko, S. B. Bin'kov; ELEKTRICHESTVO, No 3, Mar 84).....	39
ELECTROMAGNETIC COMPATIBILITY	
Component Selection (A. Grechikhin; RADIO, No 3, Mar 84).....	40
Generalized Analysis of Problems Pertaining to Design and Evaluation of Protective Fuses on the Basis of Identification and Optimization Theory, Part 2 (Kemal' Kadyrovich Namitokov, et al.; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA, No 4, Apr 84).....	40
Optimization of Information Transmission Systems by Set of Technical-Economic Indicators With Allowance for Restrictions on Variables (N. S. Gubonin; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA, No 4, Apr 84).....	41
Assessment of Effectiveness of Complex Signals Employed in Digital Transmission Systems in Channels With Concentrated Interference (Yu. G. Vishnevskiy, et al.; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA, No 4, Apr 84).....	42

Combined Algorithm for Receiving Complex Signals (A. A. Zakharov, A. S. Naumov; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA, No 4, Apr 84).....	42
Estimation of Correlation Characteristics of Random Signals With Nonstationary Mathematical Expectation (I. I. Volkov, V. K. Semenychev; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA, No 4, Apr 84).....	43
Echo Processor Operation in Matched Filter Mode (S. A. Baruzdin, V. B. Ustinov; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA, No 4, Apr 84).....	43
Signal Discrimination Against Interference Background in Acoustoptical Spectrum Analyzer (G. S. Nakhmanson, A. S. Gurevich; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA, No 4, Apr 84).....	44
A Nonparametric Algorithm of Fluctuating Signal Detection (V. P. Bezguzikov; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA, No 4, Apr 84).....	44
Assessment of the Possibility of Increasing Distance Measurement Accuracy of Radar Systems (V. I. Kondrashov; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA, No 4, Apr 84).....	45
Method for Transforming Signal Spectrum From Walsh Function Basis to Basis of Discrete Trigonometric Functions (A. V. Titov; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA, No 4, Apr 84).....	45
Determination of Distribution Density of the Moment for First Intersection of Level by Conditional Normal Process (O. A. Alekseyev, et al.; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA, No 4, Apr 84).....	46
Method for Filtering Signals Against Background of Nongaussian Noise (O. I. Shelukhin; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA, No 4, Apr 84).....	46
Estimation of Probability of Occurrence of Code Combinations of Signals Described by Gamma-Distribution (B. A. Atayants, V. P. Rumyantsev; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA, No 4, Apr 84).....	47

Effectiveness of Classification of Rayleigh and Log-Normal Interference Distribution During Adaptive Detection of Pulsed Signal (V. Yu. Volkov, M. G. Nikolayeva; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA, No 4, Apr 84).....	47
Effect of Channel Amplitude Asymmetry on Nonlinear Distortions During Dephasing Modulation (V. V. Vasyukov, V. S. Klimov; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA, No 4, Apr 84).....	48
Assessment of Effectiveness of Control Channels in Systems Employing Adaptive Signal Pre-Emphasis (V. K. Marigodov; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA, No 4, Apr 84).....	48
Expanding Dynamic Range of Receiver by Using Low-Noise Parametric Attenuator (V. I. Sineok, V. M. Bril'; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA, No 4, Apr 84).....	49
ELECTRON DEVICES	
Theory of Extended Interaction Resonant Amplifiers. I. (D. M. Vavriv, O. A. Tret'yakov; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA, No 2, Feb 84).....	50
Investigation of Startup of Magnetron With Cold Secondary-Emission Cathode at Trailing Edge of Voltage Pulse (V. D. Naumenko, S. A. Cherenshchikov; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA, No 2, Feb 84).....	50
Temperature Field in Mount of Semiconductor Device (L. I. Gorbenko, A. T. Tunik; ELEKTRICHESTVO, No 3, Mar 84).....	51
Low-Frequency Fluctuations in O-Type Cavity Oscillators With Distributed Interaction (S. G. Kurbarov, A. A. Shmat'ko; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA, No 4, Apr 84).....	52
Method for Selecting Single-Electron Photodetectors (S. S. Vetokhin, et al.; OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST', No 4, Apr 84).....	53

Five-Mirror Scanning Assembly for Infra-Red Imager With Mosaic Radiation Detector (A. A. Babayev; OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST', No 4, Apr 84).....	53
---	----

## INDUSTRIAL ELECTRONICS AND CONTROL INSTRUMENTATION

Simulation of Maintenance Process Covering Set of Production Machinery (Vladimir Grigor'yevich Zhukovskiy, et al.; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: ELEKTROMEKHANIKA, No 3, Mar 84).....	54
---	----

Principles of Design and Methods of Analysis of Cutting Speed Stabilization Systems (Grigoriy Vikent'yevich Loginov, Aleksandr Vasil'yevich Kuz'min; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: ELEKTROMEKHANIKA, No 3, Mar 84).....	54
---	----

Effect of Group Operation of Pulse Converters on Supply Source (Mark Il'ich Bronshteyn, Valeriy Ivanovich Kochkin; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: ELEKTROMEKHANIKA, No 4, Apr 84).....	55
---	----

Optimization of Power Elements in Thyristor Inverters (Anatoliy Platonovich Veselovskiy, et al.; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: ELEKTROMEKHANIKA, No 4, Apr 84).....	56
--	----

Frequency-Contrast Characteristics of Luminophor Transducer for Scanning Silicon Photodetector (A. S. Leshtayev; OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST', No 4, Apr 84).....	56
--	----

## INSTRUMENTATION AND MEASUREMENTS

Selection of Optimum Modulation Amplitude in Interference Spectrometer, Spectrum Recording a Derivative (N. F. Borisova, M. A. Gershun; OPTIKO- MEKHANICHESKAYA PROMYSHLENNOST', No 3, Mar 84).....	58
--	----

Properties of System of Transparent and Reflecting Radial Diffraction Gratings as an Angular Movement Sensor (N. N. Vorob'yev, et al.; OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST', No 3, Mar 84).....	58
--	----

Method for Determining Optimal Parameters of Photometry Systems (Ye. I. Chernov; OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST', No 3, Mar 84).....	59
--	----

Design of Optimum Magnet Structures for Inductive Tachometers (Svetlana Vladimirovna Semenova; TEKHNIЧЕСКАЯ ELEKTRODINAMIKA, No 3, May-Jun 84).....	59
Error of 'Yemkosin' Capacitive Angular-Displacement Transducer Caused by Skew of Shield Electrode (Feodosiy Borisovich Grinevich, et al.; TEKHNIЧЕСКАЯ ELEKTRODINAMIKA, No 3, May-Jun 84).....	60
Metrological Equipment Set for Duplication of Varying Magnetic Field (Vol'dmir Vasil'yevich Brayko, et al.; TEKHNIЧЕСКАЯ ELEKTRODINAMIKA, No 3, May-Jun 84).....	61
Influence of Errors of Ellipsometric Equipment on Measurement Accuracy in One Zone (R. B. Bendere, et al.; OPTIKO-MEKHANIЧЕСКАЯ PROMYSHLENNOST', No 4, Apr 84).....	62
Estimation of Contrast of Single-Band Images in Optical Observational System (V. P. Dubenskov, V. Ya. Vasil'yev; OPTIKO-MEKHANIЧЕСКАЯ PROMYSHLENNOST', No 4, Apr 84).....	62
New Signal-To-Noise Ratio Meters (L. S. Vilenchik, et al.; TEKHNIKA KINO I TELEVIDENIYA, No 4, Apr 84).....	63
'Elektronika B3-A1' Examiner Device (A. Baranov; RADIO, No 5, May 84).....	63

## MAGNETICS

Optimization of Automatic Control System for Electromagnetic Suspension by Method of Planned Experiment (Nikolay Alekseyevich Rezhko, et al.; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA, No 3, Mar 84).....	64
Electrodynamic Characteristics of Solid-State Current Pickup in Superconductor-Type Homopolar Electric Machines (Valeriy Nikolayevich Zaboin, et al.; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA, No 3, Mar 84).....	65
Breakdown of Liquid-Metal Films in Electromagnetic Field (Ivan Vasil'yevich Kazachkov, Anatoliy Fedorovich Kolesnichenko; TEKHNIЧЕСКАЯ ELEKTRODINAMIKA, No 3, May-Jun 82).....	65



## MICROWAVE THEORY AND TECHNIQUES

Photodiode Based Optrons and Optron Microcircuits (A. Yushin; RADIO, No 1, Jan 84).....	67
Weakly Localized Waves in Striplines (G. L. Gurevich, et al.; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 2, Feb 84).....	67
Backscattering Amplification Effect of Waves on Body in Regular Multi-Mode Waveguide (Kh. G. Akhunov, et al.; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 3, Mar 84).....	68
Electromagnetic Wave Propagation in Planar Waveguides With Irregular Boundaries (Surface Admittance Method) (S. V. Biryukov; IZVESTIYA VYSSHIKH UCHIBNIKH ZAVEDENIY: RADIOFIZIKA, No 3, Mar 84).....	68
Surface Admittance Method in Theory of Planar Optical Waveguides (V. G. Polevoy; IZVESTIYA VYSSHIKH UCHIBNIKH ZAVEDENIY: RADIOFIZIKA, No 3, Mar 84).....	69
Quasi-Sensory Switches Employing Microcircuits (S. Alekseyev; RADIO, No 3, Mar 84).....	69
Employment of K176 Series Microcircuits (S. Alekseyev; RADIO, No 5, May 84).....	69

## POWER ENGINEERING

Protective Automation and Complex Fault Processes in Electric Power Systems (B. I. Iof'yev; ELEKTRICHESTVO, No 3, Mar 84).....	70
Mathematical Model of A.C. Grounding Device (G. G. Puchkov; ELEKTRICHESTVO, No 3, Mar 84).....	71
Experimental Studies Concerning Dependence of Discharge Voltages Across Wide Air Gaps on Air Humidity (V. M. Rudakova; ELEKTRICHESTVO, No 3, Mar 84).....	71
Design of Helical Surge Generator (V. A. Avrutskiy, et al.; ELEKTRICHESTVO, No 3, Mar 84).....	72
Protection of Thyristors From Switching Surges in Magneto-Thyristor Pulse Generators (N. P. Polyakov, V. V. Sinenko; ELEKTRICHESTVO, No 3, Mar 84).....	73

APA-5D Airport Electric Generator-Motor Set (Kirill Mikhaylovich Yudin, et al.; TEKHNIЧЕСКАЯ ELEKTRODINAMIKA, No 2, Mar-Apr 84).....	73
Electromagnetic Compatibility in 3-Phase Systems With Rectifier Loads (Anatoliy Korneyevich Shidlovskiy, et al.; TEKHNIЧЕСКАЯ ELEKTRODINAMIKA, No 2, Mar-Apr 84).....	74
Nomogram for Determining Voltage and Current Asymmetry in Transformed Coordinates (Viktor Yakovlevich Mayer, et al.; TEKHNIЧЕСКАЯ ELEKTRODINAMIKA, No 2, Mar-Apr 84).....	74
Power Relations in Converter Circuits With Series-Parallel Connection of Transistors (Nikolay Il'ich Duplin; TEKHNIЧЕСКАЯ ELEKTRODINAMIKA, No 2, Mar-Apr 84).....	75
Comprehensive System of Main Characteristics of Semiconductor Power Devices, Part 1: Electrical Engineering Characteristics (Nikolay Nikiforovich Bondarenko, Vsevolod Borisovich Bratolyubov; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: ELEKTROMEKHANIKA, No 3, Mar 84).....	76
Synthesis of Optimum Speed Regulators for Ship Diesel-Generators (Evgeniy Nikolayevich Vereshchago; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: ELEKTROMEKHANIKA, No 4, Apr 84).....	76
QUANTUM ELECTRONICS/ELECTRO-OPTICS	
Efficiency of Adaptive Optical Systems Under Turbulent Atmospheric Conditions (M. A. Vorontsov, et al.; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 3, Mar 84).....	78
Equivalent-Circuit Parameters of Heterojunction Lasers at Currents Below Threshold (Ye. D. Karikh, A. F. Shilov; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 4, Apr 84).....	78
Fiber-Optic Observation System With Image Movement (P. A. Mikheyev, A. V. Yershov; OPTIKO- MEKHANICHESKAYA PROMYSHLENNOST', No 4, Apr 84).....	79
Lens for Recording Three-Dimensional Ensembles of Small Particles (I. M. Kliot-Dashinskaya, et al.; OPTIKO- MEKHANICHESKAYA PROMYSHLENNOST', No 4, Apr 84).....	79

Influence of Residual Stresses on Vacuum Tightness of Assemblies Incorporating Fiber-Optic Plates (V. V. Afanas'yev, et al.; OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST', No 4, Apr 84).....	80
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## SONICS AND ULTRASONICS

Multifrequency Diffraction of Light by Ultrasound (V. Yu. Petrun'kin, I. A. Vodovotov; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA, No 3, Mar 84).....	81
Domain Devices for Analog Processing of Signals (A. N. Alekseyev; IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA, No 6, Jun 84).....	81
Reflection and Refraction of Sound Waves by Domain Walls in Ferroelectric Crystals (G. G. Kessenikh, L. A. Shuvalov; IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA, No 6, Jun 84).....	82

## TRANSPORTATION

Mathematical Model for Study of Electric Traction Systems for Electric Vehicle (I. S. Yefremov, et al.; ELEKTRICHESTVO, No 3, Mar 84).....	83
---	----

## NEW ACTIVITIES, MISCELLANEOUS

'Interelektro' - Achievements and Outlook (V. V. Kleshchev; ELEKTROTEKHNIKA, No 11, Nov 83).....	84
Standardization of 'Interelektro' Special-Purpose Products (G. G. Nemtsev, V. M. Fomin; ELEKTROTEKHNIKA, No 11, Nov 83).....	85
Automated International Center of Scientific-Technical Information for Electrical Industry (F. S. Kovalev; ELEKTROTEKHNIKA, No 11, Nov 83).....	85
Activities at Berlin High-Power Testing Laboratory Within 'Interelektrotest' Organization (H. Henisch, E. Buchold; ELEKTROTEKHNIKA, No 11, Nov 83).....	86
Estimation of Parameters of Multielement Mirror in Adaptive Optical Systems (M. N. Malakhov, et al.; OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST', No 3, Mar 84).....	87

Investigation of Photolithographic Methods of Fabricating Phase Diffraction Gratings (A. A. Miroshin, et al.; OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST', No 3, Mar 84).....	87
Investigation of Temperature Conditions of Vacuum System Turret During Application of Optical Coatings (G. V. Panteleyev, et al.; OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST', No 3, Mar 84).....	88
Prospects for Development of Optical Instrument Engineering for Machine Building in People's Republic of Bulgaria (S. Stoilov; OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST', No 3, Mar 84).....	88
Investigation of Ultrasonic Separation of Optical Parts (Yu. P. Shumilov, A. V. Stepanenko; OPTIKO- MEKHANICHESKAYA PROMYSHLENNOST', No 3, Mar 84).....	89
A 'Find the Mine' Game (B. Khaykin; RADIO, No 5, May 84).....	89

UDC 621.396.628:523.164

COHERENT SIGNAL CONVERSION SYSTEM EMPLOYED IN ASTRONOMICAL CENTIMETER-BAND  
SUPER LONG-BASE RADIO INTERFEROMETER DEVELOPED BY SCIENTIFIC-RESEARCH RADIO  
PHYSICS INSTITUTE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27,  
No 2, Feb 84 (manuscript received 9 Mar 83) pp 131-135

LIPATOV, B. N. and SIZOV, A. S., Scientific Research Radiophysical Institute

[Abstract] The construction principles of a centimeter-band coherent signal conversion system employed in the super long-base astronomical radio interferometer developed by the Scientific-Research Radio Physics Institute are described. The system employs dual-frequency conversion with a 50 MHz reception bandwidth. The centimeter-band signals received are converted to the 30-76 MHz working band of the device. The performance of the coherent conversion system is evaluated by making comparison measurements with two similar systems. It is found that the signal conversion system introduces no significant distortions for coherent accumulation times of up to one hundred seconds. It was also found that the rubidium frequency standards employed make possible coherent accumulation of up to 50 seconds with practically no distortion in the form of the interference oscillation line. The long term stability is in accordance with the specifications of the Chl-69 frequency standard. Figures 3; references 6: 4 Russian, 2 Western.  
[239-6900]

ANNOUNCEMENT OF UPCOMING COLLECTION: "SPACE-TIME SIGNAL PROCESSING"

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27,  
No 2, Feb 84, pp 136, 202, 210

[Abstract] The title collection is to be published by Voronezh State University under the editorship of I. Y. Kremer and is to appear in the fourth quarter 1983. The first section, on the reception and processing of space-time signals, incorporates a number of articles on estimating the parameters of electromagnetic fields, the theory of optimum space-time resolution of signals and the theory of signals in antenna arrays. The second section, on the reception on processing of time signals, includes articles on the detection of time signals and estimating their parameters.  
[239-6900]

## METER-BAND SUPERLONG-BASE RADIO INTERFEROMETER FOR ASTROPHYSICAL RESEARCH

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 2, Feb 84 (manuscript received 9 Mar 83) pp 257-260

LIPATOV, B. N. and SIZOV, A. S., Scientific-Research Radiophysics Institute

[Abstract] Receivers employing systems for coherent conversion of the noise signals received from radio sources based on rubidium frequency standards and frequency synthesizers are developed for astrophysical research in the longwave portion of the decimeter band and the shortwave portion of the meter band. The construction principles of the meter-band receiver system are presented. Operation of the devices in the radiometer mode is described. The receiving systems can also be used in a short-base radio interferometer system with cable lines between the antennas with the use of correlation processing systems and spectral analysis of interference oscillation in real time. Figure 1; references 7: 5 Russian, 2 Western.  
[239-6900]

UDC 681.325:621.397

## COMPUTERIZED ASTRONOMICAL TELEVISION SYSTEM

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 84 (manuscript received 20 May 83) pp 222-23

KACHMIN, V. A.; MOTARYGINA, G. V., OSOKIN, V. N., POVTAR', V. I. and SINENOK, S. M.

[Abstract] A computerized astronomical television system implemented at the Kazakh SSR Academy of Sciences Astrophysics Institute is described. The system incorporates an AZT-8 telescope, television equipment, a device to encode and input the television signal to a computer, an M-220 computer and precise timing gear. The software includes programs for real time observations and result processing. The system was investigated experimentally by simulation and laboratory conditions, under actual conditions and while recording moving heavenly bodies at the Astrophysics Institute. Figures 3; references: 3 Russian.  
[283-6900]

UDC 621.371.25;537.876.23

VERY LOW FREQUENCY FLUCTUATIONS OF PARAMETERS OF EARTH-IONOSPHERE WAVEGUIDE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 2, Feb 84 (manuscript received 28 Feb 83) pp 137-146

BEZRODNYI, V. G., Institute of Radio Physics and Electronics, Ukrainian SSR Academy of Sciences

[Abstract] The statistical properties of impedance fluctuations and the altitude of the effective boundary of the ionosphere in the VLF band are investigated by the perturbation method. It is found that the properties of the effective boundary of the ionosphere are associated with the altitude distribution of electron density perturbations. The lower ionosphere can serve as a stochastic phase or amplitude screen for VLF signals, depending upon the explicit type of electron density perturbation distribution. Comparison of the simulation results with experimental data makes it possible to define the basic type of ionospheric modulation and to go from the characteristics of the effective boundary to the statistical properties of the real ionospheric plasma. The author thanks P. V. Bliokh for helpful discussion of the work and for observations made. Figures 4; references: 9 Russian.  
[239-6900]

UDC 621.371.25

PROPERTIES OF DEVELOPMENT AND RELAXATION OF ARTIFICIAL IONOSPHERIC PERTURBATION: EXPERIMENTAL RESULTS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 2, Feb 84 (manuscript received 28 Feb 83) pp 147-153

ALEBASTROV, V. A., BENEDIKTOV, Ye. A., IVANOV, V. N., IGNAT'YEV, Yu. A., SAVEL'YEV, S. M. and TEREKHOV, A. S.

[Abstract] This study presents the findings of experiments on artificial ionospheric turbulence occurring during vertical sounding of the ionosphere with powerful short wave radiation employing panoramic reception of back-scattering signals in the decameter radio wave band. The atmosphere was

perturbed by a 150 KW transmitter operating at 4.6 or 5.75 MHz. Artificial ionospheric turbulence was analyzed with the help of a transceiving complex located 1300 km from the turbulence. The sounding results are discussed in detail. It is found that the conditions for the excitation of artificial ionospheric turbulence have a strong influence on the formation of the spatial scales of the perturbation and the dynamic characteristics of artificial ionospheric turbulence. Figures 6; references 5: 4 Russian, 1 Western.  
[239-6900]

UDC 551.510.535:538.574.4

#### INFLUENCE OF CURVATURE OF PHASE FRONTS OF POWERFUL AND PROBE WAVES ON THE SCATTERING BY ARTIFICIAL PERIODIC LATTICE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 2, Feb 84 (manuscript received 7 Apr 83) pp 154-162

LAPIN, V. G. and TAMOYKIN, V. V., Scientific-Research Radio Physics Institute

[Abstract] The form of the artificial quasi-periodic electron concentration lattice formed by a powerful standing wave is found with allowance for phase front curvature for the case of a heterogeneous plasma. Conditions are identified under which a planar lattice model is valid. The influence of curvature of the phase front of the probe wave on scattering on the artificial lattice is investigated and is shown to be especially strong when the formation of an ionospheric Bragg resonator is possible. The form of the lattice in a heterogeneous ionosphere is analyzed, and the probe wave field distribution in a plasma layer containing a lattice is studied. The field reflected by a plasma layer containing a lattice is calculated. A study of the influence of absorption shows that the latter can cause a sharper drop in intensity of the scatter field when the resonator is excited. Figures 1; references 7: 6 Russian, 1 Western in Russian translation.  
[239-6900]

UDC 621.391.81

#### DIFFRACTION PROPAGATION OF CENTIMETER WAVES

Gorkiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 2, Feb 84 (manuscript received 28 Feb 83, revised 15 Sep 83) pp 163-173

DAGUROV, P. N., TSYBIKOV, A. Ye. and CHIMITDORZHIYEV, N. B., Institute of Natural Sciences, Buryat Section, Siberian Branch, USSR Academy of Sciences

[Abstract] The fine spatial structure of the diffraction field occurring during ultrashort wave propagation in hilly or mountainous terrain is experimentally investigated. The influence of the structure on the signal characteristics



is analyzed. Experiments were conducted in the centimeter band over paths including one and two peaks ranging from 5 to 110 kilometers long. The diffraction angles ranged from 2 to 53 mrad. No explicit relationship is found between the time fluctuations of the diffracted signal and the path length or the diffraction angle. The fluctuations are influenced by properties of the fine spatial structure of the diffraction field formed by diffraction and scattering on the uneven crest of the shielding relief. Even a slight shift of the receiving point can change the characteristics of the received signal significantly. The experiments indicated that the existence of maxima and minima in the spatial distribution makes it possible to improve communications conditions and noise tolerance over comparatively long paths even in the presence of signal fading. Figures 8; references 14: 10 Russian, 4 Western.  
[239-6900]

UDC 621.371.3:535.36

#### BACKSCATTERING OF WAVES BY TWO-SCALE UNEVEN SURFACE WITH ALLOWANCE MADE FOR MULTIPLE REFLECTIONS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 2, Feb 84 (manuscript received 6 Apr 83) pp 196-202

ZAVOROTNYY, V. U., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] A backscattering amplification effect analogous to that of backscattering amplification on a body in a three-dimensional randomly heterogeneous field or near the random interface between two media is found to occur in the general case of a two-scale surface when irregularities of arbitrary configuration correspond to the larger scale. A refinement of the Kur'yanov method by allowing for multiple reflections is proposed. Coherent combination of several field components associated with the occurrence of multiple reflections on the surface is found to occur in the case of backscattering. Allowance for coherent effects occurring during backscattering makes it possible to improve the results based on the energy approach employing numerical methods to study wave scattering on two-scale surfaces. References: 6 Russian.  
[239-6900]

UDC 534.4;621.396.67

#### ALLOWANCE FOR SYMMETRY OF CYLINDRICAL REFLECTOR IN NUMERICAL SOLUTION OF DIFFRACTION PROBLEM

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 2, Feb 84 (manuscript received 10 Mar 83) pp 211-216

DOBROVOL'SKIY, D. D. and IL'ICHEV, V. A., Northwest Polytechnical Correspondence Institute

[Abstract] A compact algorithm is proposed for solving the integral equation describing electromagnetic wave diffraction on a cylinder with arbitrary profile

having two axes of symmetry. The field of the incident wave is separated into even and odd components, which correspond to the even and odd components of the current distributions. The effective scattering area of the cylinder is then found from the known current distribution. The algorithm is tested by calculating the effective scattering area of a cylinder with symmetrical contour comprised of four identical arcs of a logarithmic spiral connected together. The calculation of the scattering pattern of the cylinder agrees well with measurement results for both polarizations of the incident wave. Figures 3; references 5: 3 Russian; 2 Western (1 in Russian translation).  
[239-6900]

UDC 538.574

#### ALLOWANCE FOR CORRELATION BETWEEN MEDIUM AND SOURCE IN DESCRIBING RADIATION FROM RANDOM SOURCES IN SCATTERING MEDIUM

Gorkiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 2, Feb 84 (manuscript received 18 Apr 83) pp 260-261

APRESYAN, L.

[Abstract] Dyson and Bethe-Salpeter equations for describing the first moments of random fields are extended naturally to the case of correlated sources and medium. The conditions under which this correlation can be disregarded in the Bethe-Salpeter equations are discussed on the basis of the example of thermal radiation in a randomly heterogeneous medium. References: 2 Russian.  
[239-6900]

UDC 621.371.25

#### SPATIAL CORRELATION OF VERY LOW FREQUENCY RADIO SIGNALS IN MULTIMODE GROUND-IONOSPHERE WAVEGUIDE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 3, Mar 84 (manuscript received 29 Mar 83) pp 271-276

BEZRODNYI, V. G., Institute of Radio Physics and Electronics, Ukrainian SSR Academy of Sciences

[Abstract] Variations in the type of spatial correlations at node points in the waveguide and other regions, including the vicinity of interference maxima, are analyzed in detail and given a rigorous quantitative description. The increase in the correlation coefficient of the amplitude of a signal at a frequency of  $F=15.5$  KHz in the nocturnal waveguide, which has long been interpreted as anomalous, is found to be explained by the interference nature of the random field. The conditions for the formation of regions exhibiting an anomalous drop in the spatial correlation scales of amplitude and phase fluctuations are analyzed, and the behavior of the transverse and longitudinal correlation coefficients in those regions is studied. References 10: 9 Russian, 1 Western.  
[204-6900]

## SCATTERING OF NARROW WAVE BEAM ON RANDOM IRREGULAR SURFACE IN ATMOSPHERE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 3, Mar 84 (manuscript received 26 Aug 82, revised 18 May 83) pp 294-298

BELOV, M. L. and ORLOV, V. M., Central Scientific-Research Institute for Scientific-Technical Information and Technical-Economic Research

[Abstract] The average energy characteristics of radiation in the analysis plane of a receiving lens during scattering of a narrow wave beam in the atmosphere on a random irregular surface are investigated for the case of substantial shading of certain surface elements by other elements. Formulas are derived for the radiation parameters by means of Kirchhoff's method. As an example, the ratio of the received power, considering shading to the received power and disregarding shading, is computed as a function of the parameter  $\Lambda(\theta)$  for a normal random surface with specified parameters. It is found that the aforementioned ratio becomes smaller as  $\Lambda(\theta)$  increases, but that the nature of the drop in that ratio depends upon the parameters of the source and the receiver, as well as the statistical characteristics of the random surface. Figure 1; references: 3 Russian. [204-6900]

## ELECTROMAGNETIC WAVE SPECTRUM IN TURBULENT COLLISION PLASMA AT LARGE DISTANCE FROM SOURCE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 3, Mar 84 (manuscript received 28 Apr 83) pp 299-305

GAVRILENKO, V. G. and PETROV, S. S., Gorkiy State University

[Abstract] A modified plasma perturbation method is employed to investigate the statistical characteristics of electromagnetic waves in a turbulent plasma without an electromagnetic field. The angle between the group velocity and average flux velocity is analyzed on the basis of the two cases of transverse and longitudinal propagation. It is found that diffraction effects have the greatest influence on the dispersion of the wave frequency in a nonstationary plasma during longitudinal propagation, when absorption is insignificant. The results are applicable for plasma as well as nonstationary media with other dispersions. References 9: 8 Russian, 1 Western. [204-6900]

# RESONANT INTERACTION BETWEEN BEAM WAVES AND PERIODIC LATTICE OF CONDUCTING PLANES

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 3, Mar 84 (manuscript received 3 Nov 82, revised 8 Jun 83) pp 324-331

BULGAKOV, A. A., Institute of Radio Physics and Electronics, Ukrainian SSR Academy of Sciences

[Abstract] The interaction between the waves and a beam formed in a regular heterogeneous medium and the intrinsic oscillations of a theoretic structure is examined. The study is based on a periodic system of semiconductor (plasma) layers separated by dielectric (vacuum) intervals. The semiconductor is assumed to be significantly thinner than the gap, so that the carriers in the conducting layers can be viewed as a two dimensional gas. The correction for the plasmon frequency and conditions of applicability are tabulated for different two dimensional plasmon dispersions. The author thanks N. N. Beletsk and V. M. Yakovenko for helpful discussions. Figure 1; table 1; references 13: 10 Russian, 3 Western.  
[204-6900]

UDC 621.317.743.7

# MEASUREMENT OF POLARIZATION AND PHASE PATTERNS OF ANTENNAS AND AMPLITUDE-PHASE DISTRIBUTION BY CORRELATION METHOD, USING EXTRATERRESTRIAL RADIATION SOURCES

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 3, Mar 84 (manuscript received 11 Apr 83) pp 341-349

VEKSLER, N. V., KALININ, A. V., KOROTKOV, V. S. and TURCHIN, V. I., Scientific-Research Radiophysical Institute

[Abstract] Use of the correlation method to determine the characteristics of high-gain antennas using extraterrestrial radiation sources is described. An expression is derived for the correlation matrix which allows for the polarization properties of the antennas and of the radiation from the source. Digital filtering of the results of correlation measurements of directivity patterns and a method for measuring polarization characteristics of antennas by using the randomly polarized radiation from discreet radio sources are investigated; experimental findings regarding phase and cross-polarization patterns are cited. The correlation method increases the dynamic range of the measured pattern levels by as much as a factor of two in terms of decibels as compared with methods based on measuring the output signal power. Other advantages of the correlation method are enumerated. The authors thank A. A. Romanychev and V. S. Beagon for the possibility granted by them of using the correlation apparatus of the radiointerferometer at a 55-cm wave; and N. M. Tseytlin for constant attention to the work and to number of helpful councils. Figures 9, references 11: 7 Russian, 4 Western.  
[204-6900]

## EQUILIBRIUM OF PLASMA LAYER IN HIGH-FREQUENCY ELECTROMAGNETIC FIELD

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 3, Mar 84 (manuscript received 16 Mar 83) pp 388-391

GORBUNOV, L. M., GRADOV, O. M., ZYUNDER, D. and RAMAZASHVILI, R. R., Physics Institute imeni P. M. Lebedev, USSR Academy of Sciences

[Abstract] The equilibrium of a plane layer of plasma isolated by a high-frequency electromagnetic field from contact with metal walls is examined. Two types of equilibrium states which differ in field symmetry are demonstrated. The connection between the parameters of the system in the equilibrium state is investigated. The total number of plasma particles retained by the high-frequency field is determined. Figures 3, references 6: 4 Russian, 2 Western. [204-6900]

UDC 621.371:537.874.7

## SCATTERING OF RADIO WAVES IN LONG-WAVE PORTION OF MILLIMETER BAND BY SNOW

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 3, Mar 84 (manuscript received 22 Dec 84, revised 17 Jun 83) pp 391-393

ZAKHAROV, A. S., KLEYN, A. G. and FROLOV, V. P., Yaroslavl State University

[Abstract] The results are presented of measuring the specific effective back-scattering area of snow, and the running attenuation coefficients at 35 GHz needed to determine it. The experiments were conducted with an mrl-1 weather radar augmented with a time (range) selection system to make it possible to extract the signal scattered by the hydrometeor formation in question. Values of  $\mu$ ,  $\eta$ , ranging from  $10^{-8} \text{ m}^{-1}$  to  $10^{-3} \text{ m}^{-1}$  were found with attenuation ranging from 0.2 db/km to 4 db/km. The authors thank Ye. V. Sukhonin for discussion of the results. Figure 1, references 6: 4 Russian, 2 Western. [204-6900]

UDC 535.81:535.8

## USE OF CUMULANT FUNCTION METHOD FOR STATISTICAL ANALYSIS OF DOT PATTERNS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 3, Mar 84 (manuscript received 4 Feb 83, revised 14 Jun 83) pp 393-396

KOBYANSKIY, Yu. V. and KURASHOV, V. N., Kiev State University

[Abstract] A general statistical theory of dot patterns is constructed which can logically be extended on the basis of the cumulant function method. The

Sequential examination of scattering screens is reduced to that of computing or measuring cumulant functions of different orders. The experimental conditions required for quantitative study of the parameters of diffuse surfaces are examined. Fluctuations of a scattered field by a significantly nongaussian phase screen are studied as an illustration of the statistical analysis of dot patterns. Figure 1, references 7: 3 Russian, 4 Western.

[204-6900]

UDC 523.164.53.05

# OBSERVATION OF FULL LUNAR ECLIPSE 9 JANUARY 1982 AT 3.2 MM WAVELENGTH THROUGH RT-7.5 RADIO TELESCOPE OF MOSCOW HIGHER TECHNICAL SCHOOL

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 4, Apr 84 (manuscript received 3 May 83, after completion 11 Oct 83) pp 403-409

IVANOV, V. N., LEBEDYUK, T. S., ROZANOV, B. A. and SOLOV'YEV, G. N., Moscow Higher Technical School imeni N. E. Bauman

[Abstract] The full lunar eclipse on 9 January 1982 was observed through the RT-7.5 radio telescope at the Moscow Higher Technical School. The western scanning antenna with a 7.75 m diameter was used for measurements at the 3.2 mm wavelength with vertical polarization, its radiation pattern at this wavelength being 2' wide and the sensitivity to fluctuations during a 1 s integration period not exceeding 0.7 K. The data were processed in order to yield the brightness temperatures of Copernicus and Highlands as functions of time. Electrical and thermal characteristics of the moon's upper crust have been determined from these data on the basis of the Troitskiy-Tikhonov theory of lunar radio emission, a  $\cos^{1/6}$  distribution of infrared temperature over a rough surface, and the Fresnel law of radio wave reflection. The authors thank A. A. Parshchikov and N. A. Zharkova for assistance in preparing the eclipse observation. Figures 2; tables 4; references 10: 6 Russian, 4 Western. [279-2415]

UDC 550.388.2

# INSTABILITY AT IONIC GYROFREQUENCY IN IONOSPHERIC F-LAYER

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 4, Apr 84 (manuscript received 20 May 83) pp 410-414

KRUPINA, A. Ye., Gorkiy State University

[Abstract] The buildup of ion-cyclotron instability in the ionospheric F-layer is analyzed in a quasi-hydrodynamic approximation within the range of the fundamental ion gyrofrequency, taking into account nonhomogeneity of the medium

caused by nonuniformity of the electron concentration and of the magnetic field. Calculations are based on the equality  $\nabla p_\alpha = k T_\alpha \nabla N_\alpha$  ( $N_\alpha$  - particle concentration,  $p_\alpha$  - particle pressure,  $T_\alpha$  - particle temperature,  $\alpha = e$  electrons,  $\alpha = i$  ions). An expression for the instability increment is obtained as the sum of three terms, the first term representing current instability and the other two terms representing nonhomogeneity of the medium with nonuniform magnetic field. For short waves the first term is dominant and the instability increment is determined by the current gradient. For long waves the other two terms are dominant and the instability increment is determined by the magnetic field gradient or the electron concentration gradient, whichever is more significant depending on the altitude. The author thanks B. N. Gershman for formulation of the problem and discussion of the results. References 10: 4 Russian; 6 Western.  
[279-2415]

UDC 551.510.535:538.574.4

# SCATTERING OF RADIO WAVES BY QUASI-PERIODIC IONOSPHERIC ARRAY DISTORTED BY NATURAL INHOMOGENEITIES

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 4, Apr 84 (manuscript received 3 May 83) pp 420-425

DENISOV, N. G. and LAPIN, V. G., Scientific-Research Institute of Radiophysics

[Abstract] Scattering of radio waves by a quasi-periodic ionospheric array with "electric field intensity squared" distortion of the permittivity profile by large-scale inhomogeneities is analyzed in the approximation of geometrical optics. Scattering of plane waves is calculated by the Born method. Scattering of spherical waves is calculated with the assumption that the field of the pumping wave principally fluctuated near the level of total reflection while resonance scattering occurs in lower layers. The results reveal that the spherical scattered random field is structurally identical to the diffracted field behind an amplitude-phase shield. The correlations characteristics of the probing signal after scattering by the ionospheric array are the same as those of the probing signal after specular reflection, even though both random processes are different. The authors thank V. V. Tamoykin for discussion of problems in this study. Figures 1; references: 7 Russian.  
[279-2415]



## APPROXIMATE METHODS OF SOLVING SCALAR PROBLEM OF WAVE SCATTERING BY SMOOTHLY NONHOMOGENEOUS PLASMA BODIES

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 4, Apr 84 (manuscript received 3 May 83) pp 450-455

MOROZ, A. V.

[Abstract] The scalar problem of wave scattering by a radially nonhomogeneous body, specifically a plasma cylinder of dimensions larger than the wavelength, is solved by two approximate methods of diffraction theory which extend geometrical optics from the interior of the inhomogeneity outside when the caustic surface lies far away. Both solutions, in the Kirchhoff approximation and in the modified Born approximation, are checked against a certain reference solution. The reference solution is based on the method of replacing a continuously nonhomogeneous medium with a piecewise-homogeneous one. A comparative evaluation of numerical results for a cylindrical inhomogeneity with a parabolic radial permittivity profile  $\epsilon(r) = \begin{cases} 1 - \xi(1 - r^2) & r \leq 1 \\ 1 & r > 1 \end{cases}$  indicates

that the Kirchhoff approximation is quite close for scattering angles smaller than  $90^\circ$  only, not describing the oscillations of parameters (which the reference solution does), while the modified Born approximation describes the field when the scattering angles are larger. The error of this approximation increases with increasing  $\xi$ , however, because it does not take into account the increasingly intense reflection by the permittivity gradient  $\frac{d\epsilon}{dr} = 2\xi$  at the boundary. The author thanks Z. I. Feyzulin for guidance. Figures 2; references 7: 6 Russian; 1 Western.

[279-2415]

## DIFFRACTION OF ELECTROMAGNETIC WAVES BY RECTANGULAR WEDGE PAIR

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 4, Apr 84 (manuscript received 10 May 83) pp 481-489

MAKAROV, G. I. and SOZONOV, A. P., Leningrad State University

[Abstract] The problem of diffraction of electromagnetic waves is solved analytically for two rectangular wedges forming a half-space, one with infinite electrical conductivity and one with finite dielectric permittivity, after it has already been reduced to a system of one-dimensional singular integral equations. All electric and magnetic field components in the appropriate rectangular system of coordinates are expressed through the normal magnetic field component, which must satisfy the Helmholtz equation. It is calculated, with the aid of Green's theorem, from the corresponding equation of convolution on a semiaxis. The kernel of that equation has a regular part and a difference



part. The coefficients can be expanded into a series in inverse powers of the dielectric constant as a large parameter. Then the first terms alone, which do not contain the dielectric constant, constitute the universal solution for wedges with a dielectric constant much larger than unity. This study was part of the dissertation by A. P. Sozonov, with G. I. Makarov acting as adviser. All calculations were made by A. P. Sozonov. Figures 3; references 12: 9 Russian, 3 Western (in Russian translation).  
[279-2415]

#### TWO-ELEMENT 80-METER ANTENNA

Moscow RADIO in Russian No 5, May 84 pp 22

GONCHARSKIY, Vl. and GONCHARSKIY, Vikt., Lvov

[Abstract] A two-element antenna construction is described which has all of the advantages of a quarter-wave vertical radiator and which eliminates the main shortcoming of the latter--the poor effectiveness for intracontinental radio communications. The antenna incorporates an active element which consists of an 80-meter quarter-wave vertical radiator and a passive triangular loop with perimeter close to the transmission wavelength. The top of the loop is fastened near the active element, forming an angle of 30-45 degrees with the latter. The directivity pattern of the vertically polarized loop antenna has a irregularity of about 3 dB in horizontal plane. The combination of a quarter-wave vertical radiator with its radiation maximum in the vertical plane at angles of about 20-25 degrees and a slanting loop produces an antenna with a near-circular pattern with efficiency exceeding that of a quarter-wave radiator for close and long-range contacts alike. Figures 1; references: 3 Western.  
[245-6900]

## BROADCASTING/CONSUMER ELECTRONICS

### TRANSVERTER ATTACHMENT FOR ELEKTRONIKA-KONTUR-80 EQUIPMENT

Moscow RADIO in Russian No 1, Jan 84 pp 20-23

KASMININ, G. (UAZAKR), Moscow

[Abstract] An easily-home built attachment for an 80-meter receiver or transceiver based on the Elektronika-Kontur-80 system, which permits single-sideband operation in the 10-meter band, is described. By expanding the tuning range of the basic equipment to 3.5-3.7 MHz, operation is permitted in the 28.5-28.7 MHz range. A structural diagram and schematic are presented for the proposed attachment, which incorporates an HF amplifier, an IF amplifier and mixer in the receiving section, HF, IF and power amplifiers and a mixer in the transmitting section, and a common 32.2 MHz oscillator. The operation of the circuit is traced and explained. The values of all components and board layouts are shown; step by step construction procedures are explained. Figures 5; tables 1.  
[216-6900]

### SYNCHRONIZATION OF CROSSHATCH GENERATORS

Moscow RADIO in Russian No 1, Jan 84 pp 32-33

ZELENIN, I., Moscow

[Abstract] A crosshatch pattern generator is described which eliminates the curvature in the vertical lines of the grid due to the absence of line synchronization pulses while the horizontal line pulses are present in the complete television signal. The device operates by applying the positive horizontal line pulses to one input of an AND gate before applying them to the combination device. Negative line blanking pulses are applied to the second input of the AND gate, so that segments of the line blanking pulses appear in the horizontal line pulses. The horizontal and vertical line pulses are combined in the combination device. Generators employing this principle produce a stable crosshatch pattern on the television screen. The device is also recommended for test signal generators. Figures 4.  
[216-6900]

## IMPROVEMENT TO PICTURE TUBE TESTING DEVICE

Moscow RADIO in Russian No 3, Mar 84 pp 24-25

PISH, K., Vrutki, Czechoslovakian Socialist Republic

[Abstract] A modification to a picture tube testing device previously described is proposed in order to promote restoring the emission of spent cathodes, in addition to determining the operability of black and white and color picture tubes. The existing device is modified by fabricating a new line transformer. The section which restores cathode emission incorporates a voltage tripler, a high-voltage indicator, controls and two female connection sections. The schematic diagram of the device is shown, and the operation of the circuit is explained. Figures 2; tables 1.  
[211-6900]

UDC 778.534.452

## OPTICAL SPATIAL FILTERING OF PHOTOGRAPHIC SOUND TRACKS IN WHITE LIGHT

Moscow TEKNIKA KINO I TELEVIDENIYA in Russian No 4, Apr 84 pp 14-15

LAPIDES, A. A., All-Union Scientific-Research Institute For Motion-Picture Photography

[Abstract] A method which employs an inexpensive white light source is proposed for optical suppression of noise from worn film sound tracks. A slit light source is employed with radiation spatially coherent only perpendicular to the slit, so that noise is not transferred from the original to the copy. The results of experimental tests agree with the theoretical findings. The method is recommended for restoring valuable films and for television broadcasting of old films. Figures 3; references 7: 4 Russian; 3 Western (in Russian translation).  
[240-6900]

UDC 681.84.087.47

## PHASE DISTORTIONS IN MAGNETIC RECORDING-PLAYBACK CHANNEL

Moscow TEKNIKA KINO I TELEVIDENIYA in Russian No 4, Apr 84 pp 16-18

POPOV, L. N. and SHITOV, L. V., All-Union Scientific-Research Institute for Motion-Picture Photography; Moscow Aviation Institute imeni S. Ordzhonikidze

[Abstract] Methods are analyzed for correcting phase distortions in a magnetic recording-playback channel in the mid- and high-frequency region which are caused by minimal-phase RLC circuits for correcting the channel frequency

response and limiting the bandwidth in the record and playback amplifier. A mathematical model of the record-playback channel is developed for the case of a single second-order resonant section with the high-frequency correction bands spaced equidistant from the coordinate origin. An experimental record amplifier has been developed for the MEZ-102 recorder which provides a 17-KHz bandwidth at 19 cm/s with an amplitude frequency irregularity of  $\pm 1$  dB. The phase corrector provides significant improvement in the input pulse shape, confirming effective correction of the phase characteristic of the record-playback channel. The method can be employed in movie sound recording and for normalizing the phase characteristics of sound recording equipment. Figures 9; references 7: 2 Russian; 5 Western.  
[240-6900]

UDC 771.449.76

#### UPDATED NOMENCLATURE OF MOTION-PICTURE LIGHT FILTERS

Moscow TEKHNKA KINO I TELEVIDENIYA in Russian No 4, Apr 84 pp 19-23

KURITSYN, A. M. and SHLYAKHTER, Ye. M., All-Union Scientific-Research Institute for Motion-Picture Photography

[Abstract] The basic goal of this investigation is an updated standard nomenclature of compensation and light filters for motion-picture photography that incorporates recent engineering achievements in the USSR and elsewhere. The set of compensation filters in use since 1972 is examined with an allowance made for the requirements of worldwide standards. The nomenclature is refined, obsolete types of filters are eliminated and new ones are added. On the basis of a performance and requirement analysis, it is recommended that types DB-LN and DZh-LN compensation filters, as well as nine types of effective light filters, be deleted from the list, and that additional compensation light filters be developed for metal halogen lamps. Figures 5; tables 2; references 15: 14 Russian; 1 Western.  
[240-6900]

UDC 621.397.61:681.772.7.078:681.325.5-181.4

#### USE OF MICROPROCESSORS IN TRANSMITTING TV CAMERAS

Moscow TEKHNKA KINO I TELEVIDENIYA in Russian No 4, Apr 84 pp 30-35

BYKOV, V. V., TEREKHOVA, O. I. and KHESIN, A. Ya., All-Union Scientific-Research Institute for Television and Radio Broadcasting

[Abstract] The use of microprocessors and large-scale integration circuits to ensure good picture quality and to provide identical camera settings is discussed on the basis of equipment developed outside the Soviet Union. The operating principles and comparative features of equipment produced by Harris,

Ampex, Toshiba, Phillips, RCA and others are presented. It is noted that automatic adjustment of television camera parameters under microprocessor control provides features which are especially important for reporting work. The broad capabilities of microprocessors make automatic fault-tracing possible, and allow remote control of video tape recorders. The use of automatic camera systems with several microprocessors interacting with one another is especially promising. The maximum use of digital control improves automatic camera stability and reliability. Figures 8; references: 10 Western.  
[240-6900]

UDC 621.397.2.037.372

# POTENTIAL EFFICIENCY OF DIFFERENTIAL PULSE-CODE MODULATION TELEVISION BROADCAST SIGNALS

Moscow TEKNIKA KINO I TELEVIDENIYA in Russian No 4, Apr 84 pp 36-38

KHARATISHVILI, N. G., Georgian Polytechnical Institute imeni V. I. Lenin

[Abstract] The potential (maximum achievable) efficiency of differential pulse-code modulation television signals is assessed in the light of the properties of visual perception of distortions and the visual adaptation to variations in the statistical characteristics of the coded signals. The gain in the signal/quantization noise ratio and savings in bits per sample are compared for the following: 1) PCM and differential PCM with unidimensional prediction and quantization optimized on the basis of the minimum standard deviation criterion; 2) Differential PCM using unidimensional and two dimensional predictions; 3) Differential PCM using two-dimensional and three-dimensional prediction; 4) Differential PCM using mean-square optimization and subjectively optimal quantization; 5) Parametric adaptation of differential PCM quantization with consideration given to the properties of the recipient; and 6) Adaptation of the prediction process based on the contour tracking method. The maximum achievable efficiency of differential PCM of television signals is found to be approximately 36 Db, which is equivalent to a savings of 6 bits per sample. Combining differential PCM with modified linear transformation of TV signals provides an additional savings of one bit per sample. The potential efficiency of differential PCM can be achieved by using nonparametric adaptation of the basic stages of the process in order to allow the differential PCM process to track variations in the statistical characteristics of the coded signals. Tables 1; references 13: 9 Russian; 4 Western.  
[240-6900]

## INPUT CIRCUIT OF DEVICE WITH FLAT SCREEN FOR REPRESENTATION OF TELEVISION INFORMATION

Moscow TEKNIKA KINO I TELEVIDENIYA in Russian No 4, Apr 84 pp 38-40

KAZAKOV, B. V. and RYSIN, A. A., Moscow Scientific-Research Television Institute

[Abstract] Gamma-correction schemes used to compensate for the nonlinear transfer characteristic of kinescopes are discussed. An analog  $\gamma$ -corrector is described that can be used to correct television signals with  $\gamma=2$ . A digital corrector employing a PROM that can provide practically any value of the coefficient  $\gamma$  is analyzed. A schematic diagram of the digital corrector is presented and investigated, and is found to provide satisfactory results for  $\gamma = 2$  and  $\gamma = 2.5$ . Losses in the black region are noted for  $\gamma = 3$ . A digital  $\gamma$ -corrector can be incorporated in one of the large-scale integration circuits which control a flat television screen, which is an additional argument in favor of digital correctors over analog devices. Figures 3; references 2: 1 Russian, 1 Western.  
[240-6900]

## MEASUREMENT OF TELEVISION SIGNAL FREQUENCY AND DEVIATION

Moscow TEKNIKA KINO I TELEVIDENIYA in Russian No 4, Apr 84 pp 46-50

SHAPIRO, L. Ya.

[Abstract] The operation is examined of FM television transmitters, with and without the modulating signal referenced to the original potential of the working point of the modulation characteristic. A frequency and deviation measurement method is described in which the component of the total deviation of the frequency of the measurement and television signals with respect to the null of the characteristic of the FM detector in the deviometer are converted alternately to negative and positive components of the demodulating signals, with the peak levels of the latter being converted to fixed voltage by a pulse detector. A frequency meter/deviometer is described which employs this principle. The use of the method makes it possible to alternate the measurement of the frequency and frequency deviation of FM television transmitters which employ referencing of the modulating television signal. Figures 3; references 5: 4 Russian; 1 in Russian translation.  
[240-6900]

## FORMATION OF VIEWING ZONES OF POINT-FOCUSING SCREENS

Moscow TEKHNICA KINO I TELEVIDENIYA in Russian No 4, Apr 84 pp 50-51

VOROB'YEV, A. V., OVECHKIS, Yu. N. and SEMOCHKIN, P. N., All-Union Scientific-Research Institute for Motion Picture Photography

[Abstract] Formation of the primary viewing zone with an allowance made for stopping in the optical projection system is discussed. The primary viewing zone is defined as that set of points in the object space of a point-focusing screen such that a beam of light passing through any of the points to an arbitrary point on the screen is not hindered by the stops in a multi-lens objective. Primary viewing zones for point-focusing screens can be constructed and analyzed by studying the influence of vignetting in the projection lens on the formation of the viewing zones. The findings can be used to design original projection lenses and to assess the possibility of employing standard lenses in three-dimensional projection systems. Figures 2; references: 6 Russian.  
[240-6900]

## CIRCUITS AND SYSTEMS

### LIGHT FILTER SELECTION DEVICE

Moscow RADIO in Russian No 1, Jan 84 pp 25-29

MASLOVSKIY, V. and SHAPOVAL, V., Kiev

[Abstract] A device to simplify and speed up the selection of correcting light filters for color photographic printing is described, which makes it possible to determine unambiguously the type and number of correcting light filters for particular paper, chemicals, solution temperatures, and negatives. The device operates by exposing a reduced image of the color negative through each cell of a commercial mosaic filter onto photographic paper. The exposure length is set automatically in accordance with the optical density of the filter cells. Each trial for a negative of normal density takes about 1-2 minutes. A maximum of three trials is required to determine the required light filters. Structural and schematic diagrams are presented, along with a photograph of the actual device. Figures 4.  
[216-6900]

### ASYNCHRONOUS-RESET COUNTERS

Moscow RADIO in Russian No 1, Jan 84 pp 33-34

PSURTSEV, V., Dolgoprudnyy, Moscow Oblast

[Abstract] The use of asynchronous reset inputs in integrated flip-flop and counters to construct common devices with variable capacity is described. In one version, an AND gate is connected to a binary counter so that the output signal resets the counter in order to state Y via the asynchronous inputs when X reaches some state. The operation of the device is illustrated by timing diagrams. A decade counter is also described which incorporates an integrated asynchronous binary counter and logic elements. A diagram is presented for another asynchronous-reset device which can be used to build programmable counters, i.e., counters in which the capacity is determined by outside signals. Asynchronous-reset devices are slower than binary counters because of the asynchronous reset time and the sequential switching of the flip-flops. Figures 5.  
[216-6900]



## COLOR ORGAN EMPLOYING DIGITAL SIGNAL PROCESSING

Moscow RADIO in Russian No 1, Jan 84 pp 35-37

KOVALEV, V. and FEDOSEYEV, A., Moscow

[Abstract] An automatic digital color organ is described which provides a better color pattern than existing devices. The digital color organ converts the frequency information in the signal to color information by dividing the frequency range of the music signal into three segments--low, middle and high--which are put into correspondence with a conditional 1, 2, 4 code and then converted to a conditional 0, 1, 2, 3,..., 7 code. Instead of mixing the colors on the screen as is done in traditional devices, the color mixing in the new device is performed at the electrical signal level in a decoder. The schematic diagram of the device is presented, and its operation is traced in detail. The device is simple to manufacture, adjust and operate, and it is recommended for residential and discotheque use, as well as for advertising and decoration. Figures 2.

[216-6900]

## DIGITAL-ANALOG ELEMENTS IN AUDIO FREQUENCY CHANNEL

Moscow RADIO in Russian No 1, Jan 84 pp 37-40

LUK'YANOV, D.

[Abstract] The use of digital-analog signal processing in various radio electronic devices is discussed. The digital-analog device, which occupies a position midway between analog and digital devices for processing electrical signals, generally consists of a digitizer, a processor and a filter. Simple devices are examined which incorporate no special processor, and in which all necessary changes are made to the signal in the digitizer. Schematic and functional diagrams of common digital-analog processing devices are presented. The conclusion to this two-part article is to be published later. Figures 5; references 7: 4 Russian, 3 Western (in Russian translation).

[216-6900]

## ACTIVE BAND-ELIMINATION FILTER WITH ELECTRON TUNING

Moscow RADIO in Russian No 1, Jan 84 p 41

NECHAYEV, I., Kursk

[Abstract] A band-elimination filter is proposed which can be used in sound reproduction and radio receiving equipment, as well as in music synthesizers. The schematic diagram, foil pattern and component placement pattern for the device are shown. The operation of the circuit is traced and analyzed; the basic technical specifications are tabulated. Figures 2.

[216-6900]

## METAL DETECTOR

Moscow RADIO in Russian No 1, Jan 84 pp 49-50

BULGAK, L. and STEPANOV, A., Moscow

[Abstract] An easy-to-build metal detector with relatively good sensitivity, stable operation and the ability to distinguish between ferrous and nonferrous metals is described. The device operates by beating the frequencies from two oscillators, one a reference unit and the other variable. As the coil in the oscillating circuit of the variable oscillator moves close to a metal object its inductance changes, altering the frequency of the oscillator. If the object is made of ferrous metal the inductance of the coil increases, causing the frequency of the oscillator to drop. Nonferrous metal reduces the inductance and increases the frequency of the oscillator. The schematic diagram of the device is traced and analyzed. Alignment and operation of the device are described. Figures 1.  
[216-6900]

## DIGITAL FREQUENCY INDICATOR

Moscow RADIO In Russian No 3, Mar 84 pp 29-30

NAZAROV, M., Armavir, Krasnodarskiy Kray

[Abstract] A digital frequency indicator is described for use in automatic radio control and monitoring equipment employing frequency modulation to transmit and receive information. A digital indicator employed as a filter has a near-rectangular amplitude-frequency characteristic, which makes it similar to an ideal filter; however, steps must be taken to improve the stability and increase the frequency of the reference oscillator. The digital indicator is a tracking frequency meter which analyzes the presence or absence of the required frequency in the channel. The schematic diagram of the device is shown, and the operation of the circuit is traced. Figures 2; tables 1.  
[211-6900]

UDC 621.314.2

## PARAMETERS OF SIMPLIFIED EQUIVALENT CIRCUIT WITH IRON-CORE INDUCTOR FOR OPERATION IN PULSE MODE

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 3, Mar 84 (manuscript received 28 Jun 82, after completion 7 Jul 83) pp 91-94

YAKOVENKO, VALERIY VLADIMIROVICH, candidate of technical sciences, docent, Voroshilovgrad Institute of Machine Design

[Abstract] An iron-core inductor in a simplified equivalent circuit of a pulse transformer is represented as a parallel combination of equivalent inductance

and core-loss resistance in series with the winding and source resistance. In addition to assuming a negligible leakage inductance and a constant magnetic permeability of the core material, the hysteresis loop of the latter is reduced to a single curve and then appropriately linearized. The transient response of this circuit to a step-voltage input signal is calculated by the method of Laplace transformation. The procedure is illustrated with a numerical example of a typical design and performance problem. Figures 3; references: 1 Russian. [260-2415]

UDC 681.51:53

#### DESIGN OF POLYMER LIGHT FILTERS WITH GIVEN SPECTRAL CHARACTERISTICS FOR CIRCULAR POLARIZERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 84  
(manuscript received 20 Jul 83) pp 19-21

TUSHISHVILI, M. A., MACHAIDZE, Z. A., TSISKARIDZE, K. Sh. and DADESHIDZE, V. V.

[Abstract] Light filters with assigned spectral characteristics are constructed on the basis of polymer materials. Mathematical methods are proposed which make it possible to determine the spectral composition of the light exiting the optical element, as a function of the properties of the components comprising the element. The method is tested experimentally by computer. Two types of chromatic circular polarization filters which are spectrally matched with electroluminescent mimic panels are fabricated on the basis of the light filters developed. The standard deviation of the spectral curve of the light transition of the circular polarization filter is 0.078 for one type of light filter, and 0.052 for the other. Figures 2; tables 1; references: 9 Russian. [283-6900]

#### STEP ATTENUATOR FROM MATERIALS SENT TO 'RADIO-60' COMPETITION

Moscow RADIO in Russian No 5, May 84 p 21

SKRYPNIK, V. (UY5DJ), USSR master of sport, Kharkov

[Abstract] An attenuator is described which can introduce attenuation of up to 127 dB in 1-dB steps in a 50-ohm transmission line for measuring the sensitivity and dynamic range of a transceiver or receiver. The amplitude-frequency characteristic of the attenuator is flat up to about 150 MHz. The device consists of 8 switched U-sections with resistors selected so that each section provides a definite amount of attenuation. The schematic diagram and construction of the device are described, and its operation is explained. Figures 2. [245-6900]

## HOW TO REDUCE NOISE LEVEL IN AUDIO-FREQUENCY CHANNEL

Moscow RADIO in Russian No 5, May 84 pp 35-36

ATAYEV, D. and BOLOTNIKOV, V., Moscow

[Abstract] This is the conclusion of a two-part article, the first installment of which was published in RADIO, 1984, No. 4. It is found that if several shielded wires are to be passed through a common connector, a separate contact must be provided for each braid. Polyethylene or PVC tubing should be used to prevent the braiding from contacting other braiding or metal chassis parts. The length of the wires extending beyond the braided shielding must be as short as possible. A block diagram of the connection of the stages of a pseudoquadraphonic audio amplifier is presented. Decoupling of the power supply and the functional stages is emphasized. Figures 2.  
[245-6900]

## COMMUNICATIONS

### IMPROVING EFFICIENCY OF LONG-DISTANCE TELEPHONE COMMUNICATION

Moscow VESTNIK SVYAZI in Russian No 3, Mar 84 pp 24-25

MASLENKOVA, I. P., special correspondent, VESTNIK SVYAZI

[Abstract] At the Exhibition of Achievements in the USSR National Economy a conference was held by the Main Administration of Material and Equipment Supply for the USSR Ministry of Communication, dealing with automation of long-distance telephone networks and the more efficient use of facilities. Major steps in that direction are found to be continuous planned monitoring of operations, in addition to annual distribution and processing of questionnaires. Subsequent statistical analysis of data on equipment performance indicators serves as a basis for recommendations on channel redistribution designed to reduce losses and improve service. These measures have been instituted at several territorial inspection and control centers, in Rostov, Novosibirsk, Minsk, Gorkiy, and others. One major flaw revealed so far is the poor hookup between local and long-distance exchanges. The best remedy will be further automation with increased use of microcomputers and applicable software, as well as further coordination of efforts by telephone network personnel and by republic Ministries of Communication.

[282-2415]

### IMPROVING QUALITY OF HOOKUP BETWEEN LONG-DISTANCE AND LOCAL TELEPHONE EXCHANGES

Moscow VESTNIK SVYAZI in Russian No 3, Mar 84 pp 32-33

LOPAREVA, V. S., chief, Gorkiy technical inspection and control center (TTsKU)

[Abstract] A statistical analysis of failed telephone connections, made in a 1980 study at the Gorkiy technical inspection and control center, has served as basis for introduction of new rules for technical maintenance of hookups between local and long-distance exchanges, with extensive use of control calls to test subscribers. No regular method of checking the quality of connections is available nor has as yet been proposed. It is hoped that the new rules will facilitate quality checks, but the number of control calls is still as high as 100 per exchange with a capacity of 10,000 subscribers. The old method is still used, requiring only 3 control calls per 100 subscribers served by an exchange. In addition, annual conferences are held by dispatchers throughout the Gorkiy territory on improvement of long-distance connections.

[282-2415]

## STAGES OF A MODERN TRANSCEIVER

Moscow RADIO in Russian No 3, Mar 84 pp 20-21

DROZDOV, V., (UA3AAO), Moscow

[Abstract] The mixer, oscillator and filter stages of a shortwave amateur radio transceiver built by the author are described. The mixer employs two push-pull amplifier stages with four transistors in a common-base arrangement. The oscillator is based on a VT5 low-noise transistor, and an interference-suppression filter to suppress harmonics of the transmitter signal is described. All of the stages employ easily available components. Figures 6; references: 1 Russian.  
[211-6900]

UDC 621.313.333:669.14.018-122.2(438)

ELECTRICAL GRADES OF STEEL PRODUCED IN POLAND FOR MAGNETIC COMPONENTS OF SERIES 'AI' INDUCTION MOTORS

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 83 pp 15-17

MATHEISEL, ZBIGNIEW, doctor of technical sciences, Poland

[Abstract] The new series AI induction motors now manufactured in Poland were designed at the Lodz Polytechnic Institute, following a selection and improvement study of electrical steels for this specific application. The two grades were EV plain carbon (0.06-0.08% C) steel and ER silicon steel with somewhat less silicon and more phosphorus for higher magnetic induction and better punchability, both cold-rolled nonoriented and each in the form of sheet of two gauge thicknesses: 0.50/0.65 mm (plain carbon steel) and 0.35/0.50 mm (silicon steel). Laminations of plain carbon steel were high-temperature annealed after punching, sheets of silicon steel were core plated with electrical insulation after final heat treatment. Not only the core losses  $P_{1.0T/50Hz}$  and  $P_{1.5T/50Hz}$  were measured, and checked against the guaranteed maximum, but also the magnetic induction  $B_{2.5kOe}$  and the anisotropy of magnetic induction. Special attention was paid to the effect of this anisotropy on the characteristics of steel and on motor performance. Both grades were selected as satisfactory by international ("InterELEKTRO") quality standards. Also the heat treatment of carbonized steel was optimized and the measurement of magnetic anisotropy was refined in the course of this study. Tables 3; references: 8 Polish.  
[162-2415]

## PRODUCTION OF MODERN CABLE MANUFACTURING EQUIPMENT IN CEMA COUNTRIES

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 83 pp 22-26

GREBLOV, I. M., chief, All-Union Industrial Association "Soyuzelektrokabel", and ANISIMOV, A. A., engineer

[Abstract] Ten years of assistance given by the USSR cable industry to East German enterprises (ETSK) and Hungarian enterprises (DIGEP, HITEKA, PESTVIDEKI GEDAR), within the framework of the "Interelektro" system, have resulted in development of most advance modern cable manufacturing equipment. It includes wire drawing machines (East German UDZWG for copper and aluminum wire, Hungarian DH also for nickel wire and special-purpose for large diameters), wire twisting machines (East German SRN, MKVS, MVR, Hungarian DSO), extruding machines (East German HAU, EHC) with automatic auxiliary processing lines (MEHC), and enameling machines (Hungarian PGZ). All equipment incorporates d.c. electric drives with thyristor speed control, temperature control where required, maximum automation, ventilation and noise abatement where necessary for industrial hygiene. The equipment is being installed and operates in the USSR cable manufacturing enterprises. Work on complete automation of the cable manufacturing process from raw materials to final product has already begun at the All-Union Scientific Research Institute of the Cable Industry, jointly with East German and Hungarian production machinery manufacturing enterprises.

[162-2415]

UDC 621.315.31.048.81.027.81/82

## HIGH-VOLTAGE (110/220 kV) CABLES WITH PLASTIC INSULATION

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 83 pp 26-28

PESHKOV, I. B., doctor of technical sciences, director, All-Union Scientific Research Institute of Cable Industry, POVELICHENKO, A. P., chief engineer, All-Union Industrial Association "Soyuzelektrokabel", and OBRAZTSOV, Yu. V., engineer

[Abstract] The production of high-voltage (110/220 kV) cables with plastic insulation in the USSR since the 1978-82 period is based on the General Cable Corporation system, using vulcanized low-density polyethylene in a liquid coolant. After the polyethylene has been purified, it is mixed with interlinking and stabilizing additives just before conductor and insulation materials are fed to extruders for subsequent cable assembly and hermetization. A typical cable consists of a single-conductor aluminum strand or a multiconductor aluminum core inside an aluminum sleeve, surrounded by a shield of electrically conducting polymer material, an emission shield, an insulation layer, another shield of electrically conducting polymer material, a layer of corrugated copper tape, a layer of polymer fiber, and a polyethylene outer sheath. A single aluminum conductor is 500 mm<sup>2</sup> in cross section and a multiconductor core



is larger, preferably 625 mm<sup>2</sup> in cross section. The cables are tested with alternating voltage equal to 1.73 times nominal voltage for 15 min and with alternating voltage equal to 1.45 times nominal voltage, also tested for the dielectric loss tangent at nominal voltage and with voltage surges of standard waveform and amplitude equal to 5 times (+10 kV) nominal voltage. The tests are more severe than standard CEMA tests for cables for these voltages. Data reveal that cables with plastic insulation are superior to cables with oil insulation in several respects: they withstand higher test voltages and higher normal or anomalous operating temperatures, have a lower capacitance and a smaller dielectric loss tangent. They also have a smaller mass, can be bent to smaller radii, and can be laid over longer routes with unlimited sloping. Their manufacturing and laying labor costs are lower so that replacement of an oil-insulated cable with a plastic-insulated one should yield a saving of 20,000 rubles/km. Accelerated 2500 h tests (equivalent to 96,000 h of operation) at 1.5-2.0 times nominal voltage and industrial frequency (50 Hz) or at high frequency (5 kHz) at nominal voltage, with daily temperature cycling between 95 and 130°C, have revealed not more than 100  $\mu$ m long individual tracks in the insulation. Tables 3.  
[162-2415]

UDC 621.315.3/34:331.91

#### SPECIALIZATION IN MANUFACTURE OF EXTRUSION EQUIPMENT LINES BY 'INTERELEKTRO' GROUP 7

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 83 pp 28-31

SERVANSKI, G., engineer, Hungary

[Abstract] Extrusion machinery for covering conductors and cables with plastic insulation has been built since 1963 at the Hungarian plant which specializes in manufacture of machinery for production of communication equipment. The first customer for such an extrusion process line was the Hungarian Cable Manufacturing Combine, the extruder with a 30 mm screw not having to meet severe requirements. The extruder screw diameters have increased since and the performance specifications have become more demanding, typically with respect to greater versatility. This was reflected in the subsequent 1968 and 1972 models. With assistance from the Soviet All-Union Scientific Research Institute of the Cable Industry, which arrived in 1973 within the framework of the "Interelektro" system, there have been developed most modern general-purpose extruders with 32, 45, 63, 90 mm screws for reprocessing of polyvinyl chloride and polyethylene followed by insulation of conductors and cables as well as special-purpose extruders with 32, 45, 63 mm screws for Teflon insulation with pre-drawing and post-annealing of conductors. The "Interelektro" Group 7, assigned to this project, built the second-generation KhT-452, KhT-472, KhT-601LK, KhT-602, KhT-612, FT-302, FT-312, FT-462 extrusion process lines over the 1975-80 period. Not all new concepts could be incorporated in this machinery, but most goals with regard to performance and reliability have been exceeded. Figures 5; tables 3.  
[162-2415]

## 'INTERELEKTRO' INVOLVEMENT IN MANUFACTURE OF MACHINE TOOLS

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 83 pp 33-34

KIRYUSHIN, Yu. S., engineer, POZDEYEV, A. D., doctor of technical sciences, IVANOV, A. G., candidate of technical sciences, and BOGACHEV, Yu. P., candidate of technical sciences

[Abstract] The "Interelektro" Group 9, organized in 1973, was assigned to electric drives with frequency-converter speed control for various branches of industry such as the manufacture of metal-cutting machine tools with digital program control. Accordingly, since 1976 drives have been developed with torque ratings of 7-170 N.m and power ratings up to 200 kW. Most of these drives for the USSR industry are built in Bulgaria, Czechoslovakia, Poland and Romania. They match their equivalents built by leading Western manufacturers in all technical aspects. Their distinctive features are: stepper motors and high-torque d.c. motors of "inverted" construction with high-voltage windings to eliminate transformers, and special-purpose transistor-thyristor circuits with adaptive regulators for controlling motion along as many as six coordinates. Installation of these spindle and feed drives in about 100 different models of machine tools has resulted in a 20-30% higher productivity of metal machining because of higher spindle speeds and shorter lost-time periods, in a lower unit manufacturing cost of metal parts, in a higher reliability of machine tools and simplification of their kinematics by elimination of mechanical speed converters, with attendant weight reduction and metal saving, and in a higher precision as well as product quality because of extremely low feed rate (1 mm/min or lower) and narrow-band (20-100 Hz) speed control circuits. Machine tools thus affected include milling machines, lathes and turret lathes. A typical average economic effect of introducing one of these new machine tools is 30-40 thousand rubles. Some of these machine tools are exported to capitalist countries such as Canada, Italy, France, West Germany, Sweden and Finland. Tables 2. [162-2415]

UDC 62-83(497.2):331.91

## ELECTRIC DRIVES FOR METAL CUTTING MACHINE TOOLS WITH DIGITAL PROGRAM CONTROL AND FOR INDUSTRIAL ROBOTS

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 83 pp 34-37

STANILOV, K., candidate of technical sciences, DUNDAROV, P., candidate of technical sciences, POPOV, Ye., candidate of technical sciences and ATANASOV, R., engineer, Bulgaria

[Abstract] Electric drives built in Bulgaria, within the framework of the "Interelektro" system, for metal-cutting machine tools with digital program control have torque ratings of 0.13-170 N.m and power ratings of 5.5-110 kW.

They are: SILEKTRON with 1:10,000 speed regulation (20 Hz frequency band, 33% nonuniformity at lowest speed), KEMRON with 1:20,000 speed regulation (10% non-uniformity and 4% static error at lowest speed, 35-40 Hz frequency band, acceleration without tuning) and a KEMAT variant for transformer travel mechanisms, KEMTRA with transistor-bridge converter and pulse-width modulation of 2 kHz carrier, KEMTOK special-purpose 2-coordinate drive for lathes, and KEMTOR energized from 380 V power line directly without transformer. Two other drives are now being developed in Bulgaria: for spindle rotation with frequency control of induction motors and for feed mechanism with squirrel-cage induction motors. Figures 2; tables 4.  
[162-2415]

UDC 621.319.4.002.2:331.91

# COOPERATIVE 'INTERELEKTRO' DEVELOPMENT OF SMALL LOW-VOLTAGE COSINE CAPACITORS

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 83 pp 49-50

BOCHAROV, G. A., engineer, MOROZOV, M. M., candidate of technical sciences, All-Union Scientific Research Institute of Power Capacitors

[Abstract] A cooperative effort to develop complete sets of capacitive equipment using small components and film capacitors has been undertaken by enterprises in Czechoslovakia, East Germany, Romania and the USSR, within the "Interelektro" system. High-voltage film capacitors are already manufactured in some countries, to a limited extent, so the main target of this development project are low-voltage (400 V) film capacitors for power-factor correction. Their design is based on the relation for volume of active material  $V_{ol} (cm^3) = 36\pi \frac{V^2 C}{\epsilon E^2} 10^5$  (V- operating voltage in kV, E- electric field intensity in kV/cm, C- capacitance in  $\mu F$ ,  $\epsilon$ - dielectric permittivity in  $\mu F/cm$ ). In order to minimize the volume of active material or maximize the reactive power per unit volume  $Q (kvar) = 2\pi f C V^2 \cdot 10^{-3}$  (f- frequency in Hz), it is necessary to use materials with high electric strength. With increasing electric field intensity, however, there also increases the dielectric loss  $P (kW) = Q \tan \delta$ . As most suitable material for this application has been selected polypropylene film, with low dielectric permittivity but high breakdown voltage, metallized so as to be recoverable after breakdown. Metallized paper is the plate material, such an arrangement facilitating impregnation and also allowing the metal to burn out after breakdown so as to avoid short circuits. A prototype of such a capacitor was built with a rating of 12.5 kvar (4.5 kvar/dm<sup>3</sup> and 3.6 kvar/kg) in a 3-phase configuration: three cylindrical elements inside an aluminum housing with internal protection against overpressure. Development of 50-1200 kvar low-voltage capacitors is now underway.  
[162-2415]

## STANDARD SERIES OF AUTOMATIC CIRCUIT-BREAKERS

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 83 (manuscript received 18 May 83)  
pp 51-53

MITSKEVICH, G. F., candidate of technical sciences, All-Union Scientific-  
Research Institute of Electrical Equipment

[Abstract] Standard series of low-voltage automatic circuit-breakers are being developed by the "Interelektro" Group 4, with emphasis on economy of scarce materials and reduction of manufacturing labor. They include updated second-generation models AYe2000 and A3700 as well as new third-generation models VA50. An analysis of existing equipment and its operation, manufacture and performance has revealed that 98% of all circuit-breakers in CEMA countries carry currents of up to 630 A with a switching capability of 2-25 kA at 380 V a.c., 1.5% can switch 50 kA, 0.19% can switch more than 50 kA, and 0.55% can switch selectively 20-80 kA. Critical materials are iron, nonferrous metals, silver as a separate category, and plastics. Reduction of material and labor without sacrifice of technical quality is achieved by sizing each series in multiples of 12.5 mm, the width of the smallest unit, standardizing not only sizes but also assembly and mounting dimensions, for maximum simplicity, and by uniform styling. These principles have been incorporated in two series of 630 A circuit-breakers (basic model VA51 switching 3.8-35 kA, VA52 modification with current limiter in series switching 25-55 kA) and three series of 400-1600 A circuit-breakers (current-limiting VA53 with semiconductor-type decouplers switching 48-135 kA with wide regulation of presetting and current-time characteristics, modular VA54 with VA52 current limiter in series switching 85-150 kA, selectively current-limiting VA55 with semiconductor-type decouplers switching 32-80 kA). These VA50 circuit-breakers will replace all AYe2000 and A3700 circuit-breakers now operating in the USSR within the 11th Five-Year Plan. Figures 2; tables 3.

[162-2415]

UDC 621.327:331.91

## STANDARD SERIES OF LUMINAIRES

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 83 pp 55-57

NOVOSELOV, Yu. Ye., chairman, "Interelektro" Group 8, and SHAKHPARUNYANTS,  
G. R., candidate of technical sciences

[Abstract] The "Interelektro" Group 8 has been developing several standard series of luminaires for incandescent and electric-discharge lamps according to CEMA illumination standards, with emphasis on low production cost and use of new materials such as low-shrinkage fiberglass. The USSR is the coordinator country, with Poland and Hungary as the principal other participants, for production of indoor ceiling and hanging lights for industrial plants with

likely exposure to high levels of dust and humidity as well as corrosive and flammable contaminants. One series of such luminaires is now produced in Riga. Czechoslovakia is the coordinator country for production of outdoor street lights and Romania is the coordinator country for production of bridge and tunnel lights. Hungary is the coordinator country for production of sport lighting, typical among them being metal-halide projector lamps such as the 2000 W - 1000 lm - 10,750 cd units weighing 23.5 kg produced by "EKA" in Hungary and installed in Moscow for the 1980 Olympics. The PGP series of such projector lamps in 12 sizes which cover the 400-3500 W power range, with a paraboloidal mirror-reflector, is now produced by "Vatra" in the USSR. New "build in" ceiling luminaires for horizontal mounting of lamps in various combinations and hanging luminaires for vertical mounting of lamps should be in production by 1985. Figures 4; tables 2.  
[162-2415]

UDC 621.327.532-987(439):331.91

#### TRENDS IN DEVELOPMENT OF HIGH-PRESSURE SODIUM LAMPS

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 83 pp 60-61

VIDA, D., doctor, and BALOG, B., doctor, Hungary

[Abstract] A major trend in development of lamps generally is toward higher intensity and lower power, the lumens per watt increasing linearly at first and then much slower as the vapor or gas pressure is increased. Sodium lamps are competing against xenon and mercury lamps. Low-power sodium lamps have been produced by General Electric and Tungsram since 1980. New developments include high-pressure high-intensity sodium lamps for indoor lighting, with a necessarily shorter life, and high-pressure sodium lamps with higher than 2100 K color temperature. High-pressure sodium lamps are replacing less efficient high-pressure mercury lamps. Another trend is miniaturization, small 10-15 W incandescent and compact "screw-in" low-pressure electric-discharge sodium lamps being entirely feasible. However, 20 W lamps of this type are not economically feasible. The main problem in miniaturization is providing adequate cooling or standby for the cooling period, and the high cost of producing such lamps--which could be compensated by their high efficiency and long life. Figures 4.  
[162-2415]

UDC 621.32:331.91

#### NEW ECONOMICAL LIGHT SOURCES

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 83 pp 62-63

KOKINOV, A. M., engineer, and SMAKAYEV, Ye. I., engineer, All-Union Scientific Research Institute of Light Sources

[Abstract] The "Interelektro" Group 8 is developing new light sources for CEMA member countries, with emphasis on high efficiency and low cost. Alongside

appropriate light measuring methods and instruments as well as CEMA certification standards are under development. Items already in production are halogen-filled lamps for automobiles and for airports, as well as metal-halide lamps. The next target is home and office lighting, with incandescent or electric-discharge lamps. The main problem in this area are high-speed high-volume production, requiring special tools, and long-range forecasting based on market research in terms of spectral and intensity characteristics as well as sizes and shapes. Another important concern is economy, within the framework of the overall energy conservation program, considering that in industrial countries 8-20% of all the produced electric energy is spent on lighting. Low-power high-pressure gas-discharge lamps featuring high efficiency and long life are now being developed as a contribution to this program. Tables 1.  
[162-2415]

UDC 535.853.4

#### INTERFERENCE SENSOR OF POSITION OF ACHROMATIC BAND

Moscow OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 3, Mar 84  
(manuscript received 24 Mar 83) pp 21-22

MASLENKOV, V. K., USTINOVA, N. M. and TSVETKOV, V. A.

[Abstract] An interference sensor is proposed for automatic adjustment of a telescope mirror. The sensor incorporates a lateral-shift interferometer which detects distortions in the wave front, and an optoelectronic device which analyzes the interference pattern at the interferometer output. A functional diagram of the device is presented. Two possible operating modes are described: searching for the detail with the highest contrast, i.e. an achromatic band, and precise determination of the displacement of said detail with respect to the optical axis. The device is recommended for real-time mirror adjustment when the perturbing input frequency is 1 hertz or less. Figures 2; references: 3 Russian.  
[261-6900]

UDC 666.1.037.98:(681.7.068.42):621.9.529

#### IMPROVING QUALITY OF REFLECTOR SURFACES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 84  
(manuscript received 18 May 83) pp 27-30

MIKHNEV, R. A., SAVEL'YEV, V. A., CHECHETKOVICH, A. A. and SHTANDEL', S. K.

[Abstract] The use of numerically controlled machine tools to improve the accuracy of glass sagging forms is described. The choice of linear versus circular interpolation of the contour followed by the cutting tool is discussed. The operating program for calculating the contour of the generating surface of

the form is described. The surface accuracy of sagged reflectors produced on forms cut on numerically controlled machines is analyzed in terms of amount and sign of longitudinal zonal aberrations. Forms cut using circular interpolation of the trajectory of the cutting tool produce reflectors with better aberration characteristics than those produced on forms cut using linear interpolation of the trajectory. Figures 3; references: 5 Russian.  
[283-6900]

#### MORE INFORMATION ON S1-94 OSCILLOGRAPH AND ATTACHMENTS FOR IT

Moscow RADIO in Russian No 5, May 84 pp 41-44

BOGDAN, A.

[Abstract] Reader response to articles previously published on the design and construction of a home-built S1-94 oscillograph is reported. Construction of the delay line in the vertical deflection channel is discussed in detail. The addition of a decibel scale to the device, along with a method for expanding the measurement range to 40 to 60 dB is described. A number of attachments proposed by readers in order to make the oscillograph more versatile are described. These include an active probe and a modification to allow the device to perform some of the functions of a dual-trace oscillograph. The schematic diagram of a device for measuring the capacitance of polar and nonpolar capacitors is presented. Use of the oscilloscope for color television alignment is described. Figures 6; tables 2.  
[245-6900]

#### HIGH-FREQUENCY POWER AMPLIFIER

Moscow RADIO in Russian No 5, May 84 pp 29-34

SOLNTSEV, Yu., Moscow

[Abstract] Basic requirements for the power amplifier employed in a modern high performance sound playback system are formulated. It is specified that the frequency range must be at least 20-20,000 Hz for an output voltage corresponding to nominal output power; the harmonic coefficient in that band must not exceed 0.03%, and the slope of the output voltage must be at least 2.5 V/msec. The transient response of the amplifier must be smooth (with no spikes), and the phase frequency characteristic must be linear throughout the entire audio frequency band. A high performance power amplifier based on the QUAD 405 is developed. A schematic diagram, which incorporates 10 transistors, is presented and its operation is traced. The circuit board foil pattern and component layout are presented. Evaluation by a panel of listeners confirmed that the design approach employed is correct, and that the standards set for the basic parameters are appropriate. Figures 4; tables 1; references 9: 8 Russian, 1 Western.  
[245-6900]



## COMPUTERS

### MICROCOMPUTER RECEIVES AND TRANSMITS TELEGRAMS

Moscow VESTNIK SVYAZI in Russian No 3, Mar 84 p 34

SEMENYUTIN, A. V., chief of production laboratory, Tallinn Telegraph System

[Abstract] In the Tallinn telegraph center since recently telegrams are received from the message switching station and transmitted to the channel switching station by an "Elektronika DZ-28" microcomputer with a 16 kbit read-only memory. The microcomputer and the "Telegraf" programmed automatic telegram input device as well as the telegraph signal receiver and the telegram transmitter are all linked through a four-terminal interface containing 19 series K155 microcircuit chips. Telegrams are received and transmitted concurrently. The memory plays back the texts of telegrams during short breaks in the connection between microcomputer and automatic input devices. Introduction of the microcomputer has resulted in an annual cost saving of 3,868 rubles. Figures 2.  
[282-2415]



UDC 62-503.4

'RECURRENCE' CRITERION OF STABILITY AND EXPANSION INTO CONTINUED FRACTION

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKА in Russian No 3, Mar 84 (manuscript received 18 Nov 81, after completion 1 Apr 82) pp 116-119

LEBEDEV, ANDREY NIKOLAYEVICH, doctor of technical sciences, professor, Leningrad Institute of Electrical Engineering

[Abstract] A "recurrence" criterion has been proposed by Ye. A. Naumov (ELEKTROMEKHANIKА No 9, 1981) for stability analysis of linear stationary automatic control systems on the basis of the characteristic polynomial  $f(z) = a_0 z^n + a_1 z^{n-1} + \dots + a_n$ . Its alleged advantage over Routh's criterion is the absence of zeros in the first column and attendant singularities requiring an algorithm with small parameter. According to Ye. A. Naumov, successive modifications of the fundamental Routh algorithm lead to a form, namely the third form, which effectively is the "recurrence" algorithm in reverse. A. N. Lebedev demonstrates here that this third form of the Routh algorithm still contains zeros in the first column. With respect to a minimum number of arithmetic operations, the fundamental Routh algorithm is still most expedient for computer calculations and its second form is most expedient for hand calculations. A related problem is expansion of a quotient of two infinite polynomials into a continued fraction. Calculation of the elements of this fraction according to the Routh algorithm in any of its three forms is proposed here, a method much simpler than convolution of the fraction proposed by Ye. A. Naumov. References: 6 Russian.  
[260-2415]

UDC 62-501.433

ZEROES OF CONTROL SYSTEMS WITH MONITORING DEVICES

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKА in Russian No 4, Apr 84 pp 53-55

GAYDUK, ANATOLIY ROMANOVICH, candidate of technical sciences, docent, Taganrog Institute of Radio Engineering, and LUTSKIV, NIKOLAY MIKHAYLOVICH, candidate of technical sciences, docent, Ukrainian Institute of Polygraphy

[Abstract] The transfer functions of control systems with monitoring devices are analyzed, for zeroes rather than for the already well known poles.

Specifically, a fully observable and controllable object is described by the system of equations  $\dot{x} = Ax + bu + b_1 f$ ,  $y = cx$  ( $x$  -  $n$ -dimensional vector of state variables,  $u$  - scalar control,  $f$  - scalar perturbation,  $y$  - controllable variable of object,  $A$  -  $n \times n$  constant matrix,  $b, b_1, c$  - coefficient vectors of appropriate dimensionality). Only  $y, u, f$  are assumed to be accessible to measurement and the control is defined as  $u = kx + v$  ( $v$  - driving action,  $k$  - vector of feedback coefficients,  $\hat{x}$  - vector of state variables of monitoring device:  $\hat{x} = [A - lc] \hat{x} + ly + qu + q_1 f + q_0 v$  where  $l, q, q_0, q_1$  -  $n$ -dimensional vectors of constant coefficients). The two transfer functions of such a system, one with respect to driving action and one with respect to control, are found to be both degenerate with shrinking multipliers and to have the same zeroes. Consequently, the zeroes of such a system are not controllable, but the poles are. The zeroes can, however, be varied by departure from conventional procedure and selection of  $q \neq b$ ,  $q_0 \neq 0$ ,  $q_1 \neq b_1$ . Then the transfer functions cease to be degenerate, the number of poles becomes  $n + r$ , and the number of zeroes becomes larger.

References: 5 Russian.

[244-2415]

UDC 621.319.4:621.315.61-418:537.226.001.57

SELF-RECOVERY OF ELECTRIC STRENGTH BY METALLIZED DIELECTRICS

Moscow ELEKTRICHESTVO in Russian No 3, Mar 84 (manuscript received 23 Aug 83)  
pp 72-74

PETRENKO, L. G. and BIN'KOV, S. B., Kharkov

[Abstract] Processes occurring in the immediate vicinity of a breakdown site in the dielectric of a metallized-dielectric device such as metal-paper or metal-film capacitors are analyzed on the basis of a thermophysical model and its mathematical description. A rectangular current pulse is assumed to propagate through the dielectric perpendicularly to its surface and through the metal layer radially parallel to the surface following a breakdown. Melting and evaporation of the metal result in formation of a demetallization zone, to the edge of which current from the breakdown channel can flow either along the dielectric surface or along an arc through the metal vapor. The temperature and the thickness of the metal layers as functions of time are obtained from the corresponding system of differential equations. The solution yields the time required for all the metal to evaporate, corresponding to zero layer thickness, and also the dimensions of the demetallization zone. The radius of the latter is found to be inversely proportional to the initial thickness of the metal layer. Calculations for the two extreme cases of slow heating only and fast evaporation reveal the mechanism of recovery as well as the conditions for spontaneous recovery of electric strength. Such calculations are made for zinc and aluminum, a zinc coating becoming 40% more demetallized than an aluminum one under the same conditions, also for coatings of uniform and nonuniform thickness. An approximately linear relation between the demetallization radius and the capacitor voltage at the instant of breakdown has been established on the basis of experimental data, assuming an instantaneous rise of the current and a constant current during the discharge period. Figures 5; references 6: 3 Russian, 3 Western (2 in Russian translation).  
[280-2415]

## ELECTROMAGNETIC COMPATIBILITY

### COMPONENT SELECTION

Moscow RADIO in Russian No 3, Mar 84 pp 18-20

GRECHIKHIN, A., (UA3TZ), Gorkiy

[Abstract] The use of component selection of electromagnetic signals, which exploits the difference in the ratios of the electrical and magnetic components of the electromagnetic fields of the signals to be separated, is described. The physical foundations and fundamentals of component selection are presented. Examples of the use of component selection in order to improve the noise tolerance and real selectivity of receiving devices near noise sources and to suppress interference in a common channel containing a valid signal is described. The employment of component selection in conjunction with space and polarization selection and various methods of processing the valid input signal-to-noise mixture is described. Figures 5; references 4: 3 Russian; 1 Western in Russian translation.  
[211-6900]

UDC 621.316.923

### GENERALIZED ANALYSIS OF PROBLEMS PERTAINING TO DESIGN AND EVALUATION OF PROTECTIVE FUSES ON THE BASIS OF IDENTIFICATION AND OPTIMIZATION THEORY, PART 2

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 4, Apr 84 (manuscript received 21 Dec 81) pp 56-62

NAMITOKOV, KEMAL' KADYROVICH, doctor of technical sciences, professor, Kharkov Institute of Civil Engineering, IL'INA, NATAL'YA ALEKSANDROVNA, candidate of technical sciences, senior scientific associate, and SHKLOVSKIY, IL'YA GRIGOR'YEVICH, candidate of technical sciences, senior scientific associate, both of All-Union Scientific Research Institute of Electrical Apparatus, Kharkov

[Abstract] A relation between identification and optimization, under both functional and regional constraints, is established on the basis of general methodology for a protective fuse as a specific object and a representative of low-voltage devices. Although the relation is hierarchical, identification preceding optimization, both problems also can be solved not only sequentially but in parallel. The optimality criterion either has or has not been defined

analytically. In the first case there are available theoretical and numerical methods of optimum search, those based on the variational principle being more expedient when the optimality criterion is a simple function without constraints on the arguments and the Pontryagin maximum principle being more expedient otherwise. Most general and, therefore, most common as well as most unwieldy are multi-extremal nonlinear criteria combined with nonlinear constraints. All special methods devised for solving such problems fall into three groups: 1) direct search for the extremum; 2) gradiental search, for direction to the extremum; 3) selection of an iteration step for approaching the extremum along given direction (Fibonacci procedure, golden-section procedure, dichotomic sequential search, random search) when the optimality criterion has a discontinuous first derivative, or is an implicit function or has several extrema. When the optimality criterion has not been defined analytically, but the parameters determining the constraints are known, then the optimum can only be sought by experiment. The object must be identified first and then can be optimized by any of these methods, optimum search by sifting not being practical for low-voltage devices generally and fuses or circuit breakers especially. References: 5 Russian.

[244-2415]

UDC 621.391.26

# OPTIMIZATION OF INFORMATION TRANSMISSION SYSTEMS BY SET OF TECHNICAL-ECONOMIC INDICATORS WITH ALLOWANCE FOR RESTRICTIONS ON VARIABLES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 4, Apr 84 (manuscript received 8 Apr 83) pp 3-9

GUBONIN, N. S.

[Abstract] A solution is obtained to the problem of vector optimization of a simplex information transmission system with respect to the unconditional preference criterion with allowance for bilateral restrictions on the varied "energy" parameters. An optimal surface (multidimensional transfer diagram) equation is derived which corresponds to the non-worst-case set of simplex information transmission systems with respect to cost, data rate, hardware reliability and noise tolerance. A simplex transmission system consisting of a coder, a transmitter, a transmitting antenna, a receiving antenna, the input section of a receiver and a decoder is examined. The construction of a multidimensional exchange diagram is analyzed. A formula is derived for the transfer diagram, and optimum technical parameters are programmed, so that different "sections" of the diagram (i.e., the family of two dimensional transfer diagrams of the performance indicators of interest) can be obtained in the interactive mode. The formula derived can be used to create optimization models of higher-level systems incorporating several information transmission systems. Figures 3; tables 2; references 4: 3 Russian; 1 Western (in Russian translation). [210-6900]

## ASSESSMENT OF EFFECTIVENESS OF COMPLEX SIGNALS EMPLOYED IN DIGITAL TRANSMISSION SYSTEMS IN CHANNELS WITH CONCENTRATED INTERFERENCE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 4, Apr 84 (manuscript received 23 Dec 82) pp 20-26

VISHNEVSKIY, Yu. G., SIKAREV, A. A. and SOBOLEV, V. V.

[Abstract] The generalized criterion of a "signal damage field" is introduced in order to estimate the effectiveness of a choice of signals with an allowance made for such communications system operating factors as the difference in the frequency-time structure of the signals and concentrated interference, statistical properties of the communications channel and signal demodulation conditions in the receiver. This criterion makes it possible to investigate more fully the possibilities and effectiveness of using different types of complex signals in binary digital transmission systems for channels subject to simultaneous fading, noise and concentrated interference. The use of the concepts of partial and resulting damage field in studying communication systems is discussed. An example of a binary coherent receiving system which is optimal for channels with random noise is examined for the case of parallel, serial and serial-parallel complex signals. Analysis of the damage fields shows that a radio communications system will be practically inoperable if the carrier frequency of the interference and its time delay are characterized by point coordinates belonging to the resultant damaged field. In addition, the radio communications system may become inoperable when the carrier frequency of the interference differs significantly from the center frequency of the signal spectrum. The size of the damage fields depends upon the base of the signal as well as the coding principle, which is particularly evident in signals with parallel structure. Figures 1; tables 1; references: 4 Russian.  
[210-6900]

UDC 621.391.019.4

## COMBINED ALGORITHM FOR RECEIVING COMPLEX SIGNALS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 4, Apr 84 (manuscript received 15 Feb 83 after revision) pp 26-31

ZAKHAROV, A. A. and NAUMOV, A. S.

[Abstract] A relatively easily implemented asymptotically optimal combined algorithm is proposed for channels with independent gaussian multiplicative and additive noise. The optimal reception device for such channels incorporates a demodulator which computes the likelihood coefficients, and a receiving device which uses the likelihood coefficients to make a decision in favor of a particular version of the complex signal (code vector). A combined receiving algorithm for majority codes with separate (orthogonal) checks is constructed and shown to be asymptotically optimal. A statistical experiment is described in which the

combined algorithm is used to receive separately coded messages. It is found that the noise tolerance of the combined algorithm is practically the same as the noise tolerant optimal algorithm and the combined modified ranking algorithm. The combined algorithm is recommended for practical use. Figures 1; references: 11 Russian.  
[210-6900]

UDC 62-503.32-543.42

#### ESTIMATION OF CORRELATION CHARACTERISTICS OF RANDOM SIGNALS WITH NONSTATIONARY MATHEMATICAL EXPECTATION

Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 4, Apr 84 (manuscript received 27 Oct 83 after revision) pp 38-42

VOLKOV, I. I. and SEMENICHEV, V. K.

[Abstract] A two-stage signal centering process is proposed which ensures little bias of the estimates of the correlation characteristics introduced by the centering filter, regardless of the type of correlation function, which is easily implemented in hardware. It is shown analytically that the bias of the estimates of the series of correlation characteristics can be made arbitrarily small. An expression is derived for the bias of the estimates of the moments of the correlation function. The possibility is presented of extending the proposed approach to the measurement of other moment characteristics of random signals, and with other types of nonstationarity of mathematical expectation. Figures 1; references 5: 4 Russian, 1 Western.  
[210-6900]

UDC 621.391.26

#### ECHO PROCESSOR OPERATION IN MATCHED FILTER MODE

Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 4, Apr 84 (manuscript received 13 May 83) pp 49-54

BARUZDIN, S. A. and USTINOV, V. B.

[Abstract] Degradation in the noise tolerance of an echo processor operating as a matched filter is analyzed for signals of arbitrary duration. Three matched filter constructions are examined. The characteristics of devices for correcting relaxation distortions are presented. There are losses in noise tolerance in all three versions, resulting from relaxation processes, which increase as the normalized signal duration. The findings can be used to calculate the noise tolerance of echo processors with an allowance made for the losses caused by relaxation processes of signals whose duration is comparable with the relaxation time. The use of fast gain control to eliminate these losses makes an echo processor equivalent to a matched filter. Figures 2; references: 8 Russian.  
[210-6900]

# SIGNAL DISCRIMINATION AGAINST INTERFERENCE BACKGROUND IN ACOUSTOPTICAL SPECTRUM ANALYZER

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 27, No 4, Apr 84 (manuscript received 15 Feb 82 after revision) pp 54-58

NAKHMANSO, G. S. and GUREVICH, A. S.

[Abstract] Signal discrimination against the background of external interference and internal optoelectronic system noise in an acoustooptical spectrum analyzer is examined. The influence of the number of quantization levels of the decision device in the optoelectronic system and of the signal-to-interference and signal-to-noise ratios on the probability of correct discrimination is analyzed. The discrimination of signals representing a set of narrowband components and a rectangular radio pulse against the background of white noise and internal system noise is examined as an example which illustrates the findings. Good probabilities of correct discrimination are achieved when the signal-to-noise and signal-to-interference ratios are higher than the Q-factors needed for reliable measurement of spectral parameters (with frequency) of the signals. The probability of an incorrect signal discrimination decision is strongly influenced by the distribution of the spectral components of the signals on the frequency axis and their amplitudes. Tables 1; references: 8 Russian.  
[210-6900]

UDC 621.391.019

# A NONPARAMETRIC ALGORITHM OF FLUCTUATING SIGNAL DETECTION

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 27, No 4, Apr 84 (manuscript received 19 Nov 83 after revision) pp 66-67

BEZGUZIKOV, V. P.

[Abstract] Nonparametric detection algorithms are constructed which provide superior performance in typical situations by taking into account the type of fluctuations of the detected signal and the statistical characteristics of the interference at the input of the detector of a radar channel. A rule is derived for forming the decision statistic which is locally most powerful for the conditions under consideration and which reduces computational costs and relaxes the requirements for component speed for real time signal processing. References 4: 2 Russian; 2 Western (in Russian translation).  
[210-6900]



## ASSESSMENT OF THE POSSIBILITY OF INCREASING DISTANCE MEASUREMENT ACCURACY OF RADAR SYSTEMS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 4, Apr 84 (manuscript received 15 Nov 83) pp 71-72

KONDRASHOV, V. I.

[Abstract] It is demonstrated that the contradictory requirements for the envelope and spectrum of a ranging signal can be resolved by using internal frequency modulation of the radio pulses. The temporal and spectral characteristics of such FM signals are compared with the characteristics of single-frequency signals having rectangular and bell-shaped envelopes. It is found that a signal with a rapidly oscillating phase modulation function provides distance measurement accuracy equalling that of a rectangular single-frequency signal. Narrowband FM signals are found to be promising for use in noise tolerant range measuring devices in which the frequency resolution requirements are high. Figures 1; references: 3 Russian.  
[210-6900]

UDC 621.391.2

## METHOD FOR TRANSFORMING SIGNAL SPECTRUM FROM WALSH FUNCTION BASIS TO BASIS OF DISCRETE TRIGONOMETRIC FUNCTIONS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 4, Apr 84 (manuscript received 25 Nov 83 after revision) pp 72-74

TITOV, A. V.

[Abstract] The concept of a modified discrete trigonometric function matrix is introduced, in which the row numbers are defined in the same way as in a discrete trigonometric function matrix. The spectral characteristics of Hadamard-ordered Walsh functions are examined. The number of multiplications required to go from the Walsh basis to the discrete trigonometric function basis is analyzed. It is found that the method based on first computing the elements of the Fourier nucleus matrix with  $N \leq 64$  makes it possible to reduce significantly the number of multiplications. References: 3 Russian.  
[210-6900]

# DETERMINATION OF DISTRIBUTION DENSITY OF THE MOMENT FOR FIRST INTERSECTION OF LEVEL BY CONDITIONAL NORMAL PROCESS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 27, No 4, Apr 84 (manuscript received 5 Jul 83 after revision) pp 74-75

ALEKSEYEV, O. A., BUGA, N. N. and YEGOROV, V. V.

[Abstract] Quantitative estimates of the density function of the time to first intersection of a given level by a random process are derived, with the assumption that a realization has respective values of  $a_{-(n-1)}, \dots, a_{-1}, a_0$  at moments at moments  $t_{-(n-1)} < \dots < t_{-1} < t_0$ . The event in question is assumed to be a stationary centered gaussian process which is mean-square differentiable with a normalized correlation function. Under given conditions, the process can be viewed as a nonstationary random process that has been reduced to a stationary one. The estimates derived are simple and can be employed for computer analysis.

References: 3 Russian.

[210-6900]

# METHOD FOR FILTERING SIGNALS AGAINST BACKGROUND OF NONGAUSSIAN NOISE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 27, No 4, Apr 84 (manuscript received 3 Aug 83 after revision) pp 76-78

SHELUKHIN, O. I.

[Abstract] Nonlinear conversion of the input process prior to linear filtering of signals against a background of nongaussian interference is examined. A linear filter augmented with nonlinear transformation is described. A case of weak signals for which the signal-to-noise ratio is significantly smaller than unity is analyzed as an example. The effect of adding a nonlinear transformation block is analyzed. It is found that the more the input distribution differs from normal, the greater will be the effect of using such a block. The results agree sufficiently well with analogous results for asymptotically optimal estimation algorithms. Figures 2; tables 1; references: 3 Russian.

[210-6900]

# ESTIMATION OF PROBABILITY OF OCCURRENCE OF CODE COMBINATIONS OF SIGNALS DESCRIBED BY GAMMA-DISTRIBUTION

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 4, Apr 84 (manuscript received 11 Oct 83 after revision) pp 78-80

ATAYANTS, B. A. and RUMYANTSEV, V. P.

[Abstract] The minimum connectedness is determined for which a discrete model described by a  $\mathcal{V}$  - connected Markov chain provides satisfactory agreement with a model obtained through experimentation. The square of the amplitude of the input signal is described by a gamma distribution. A formula is derived for the probability of occurrence of code combinations for circuits with connectedness not exceeding unity. The results are compared with code combination distributions determined experimentally by a computer for a sample of 150 signal realizations. The description error computed according to the Kolmogorov agreement criterion is 17% for  $\mathcal{V} = 0$ . Increasing  $\mathcal{V}$  to unity cuts the error in half. There is no justification for increasing the connectedness further, because the description accuracy is not increased enough to offset the complication of the statistical model. Figures 2; references 2: 1 Russian; 1 Western in Russian translation.  
[210-6900]

UDC 621.396.96

# EFFECTIVENESS OF CLASSIFICATION OF RAYLEIGH AND LOG-NORMAL INTERFERENCE DISTRIBUTION DURING ADAPTIVE DETECTION OF PULSED SIGNAL

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 4, Apr 84 (manuscript received 21 Oct 83 after revision) pp 82-84

VOLKOV, V. Yu. and NIKOLAYEVA, M. G.

[Abstract] The effectiveness of an adaptive detector which changes threshold levels in accordance with the classifier signals is examined. It is found that the use of an interference classifier complicates the structure of the detector, but the complication is offset by the fact that a gain in the threshold signal-to-interference ratio can always be identified. If classification performance is poor and the probability of occurrence of a particular type of interference is unknown it becomes less advisable to use a classifier. If substantial changes in the type of interference which require the threshold level to be increased significantly are not encountered very frequently, it is advisable to use an interference classifier in adaptive detection. Figures 1; references 7: 3 Russian; 4 Western (1 in Russian translation).  
[210-6900]

EFFECT OF CHANNEL AMPLITUDE ASYMMETRY ON NONLINEAR DISTORTIONS DURING  
DEPHASING MODULATION

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 4, Apr 84 (manuscript received 11 Jul 83) pp 86-87

VASYUKOV, V. V. and KLIMOV, V. S.

[Abstract] Amplitude differences in the channels resulting in nonlinear distortions in power amplifiers primarily caused by spread in the parameters of the amplifying devices are analyzed. The coefficient of nonlinear distortions is analyzed as a function of the ratio of the complex amplitudes of the channel voltages. In agreement with experimental findings, it is asserted that the contribution of parasitic phase modulation to increased nonlinear distortions can be disregarded. Figures 2; references 2: 1 Russian; 1 Western.  
[210-6900]

UDC 621.396.621.391.27

ASSESSMENT OF EFFECTIVENESS OF CONTROL CHANNELS IN SYSTEMS EMPLOYING ADAPTIVE  
SIGNAL PRE-EMPHASIS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 4, Apr 84 (manuscript received 20 Jun 83 after revision) pp 87-88

MARIGODOV, V. K.

[Abstract] The relative throughput capacity of the information and control channels in transmission systems employing adaptive pre-emphasis and correction is investigated. The reduction in standard deviation in the control channel for models of real signals is determined. The relative throughput capacity is estimated for a television broadcast system and for a facsimile transmission system operating over a standard radio relay voice grade channel. The method employed can be extended to other models of signals and interference in channels being compared. The formulas derived can be used to make an information-theoretic estimate of the potential effectiveness characteristics of transmission and information processing systems as a whole. Figures 1; references 3: 2 Russian; 1 Western.  
[210-6900]

## EXPANDING DYNAMIC RANGE OF RECEIVER BY USING LOW-NOISE PARAMETRIC ATTENUATOR

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 4, Apr 84 (manuscript received 30 May 83 after revision) pp 92-94

SINEOK, V. I. and BRIL', V. M.

[Abstract] A low-noise parametric attenuator is examined which can be used to compress the amplitude range of input signals without significant degradation of receiver parameters. The attenuator incorporates a parametric device consisting of a parametric diode, a signal filter, a pumping filter and a combination-frequency filter, plus an adaptive channel consisting of a narrow band preamplifier, frequency converter and pumping amplifier. The operation of the device is described, and the gain provided is plotted as a function of the input signal amplitude. It is found that the suppression of the amplitude of the input signal increases as the amplitude of the input signal and the gain of the adaptive channel. The use of a parametric amplifier makes it possible to regulate the signal suppression coefficient in proportion to the amplitude of the carrier signal alone. It is shown possible experimentally to expand the dynamic range of the receiver by 15 Db. Figures 2; references: 3 Russian.  
[210-6900]

UDC 621.385.62.01

THEORY OF EXTENDED INTERACTION RESONANT AMPLIFIERS. I.

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 2, Feb 84 (manuscript received 13 Jul 82; in final version, 6 Sep 83) pp 238-249

VAVRIV, D. M. and TRET'YAKOV, O. A., Kharkov State University

[Abstract] A self-consistent system of equations is derived which describes the excitation mode of oscillations in high-Q extended interaction resonant systems. An analytical solution is obtained for a small input signal and beam currents smaller than the resonator starting current. Explicit formulas are obtained for the amplitude and phase of the field in the resonator, the electron gain and electron efficiency of the amplifier, the working bandwidth and the maximum gain within that band. It is shown that extended interaction resonant oscillators (resonant backward-wave tubes) can be used to build regenerative amplifiers with characteristics suitable for use in the millimeter wave band. Figures 5; references: 11 Russian.  
[239-6900]

UDC 621.385.64

INVESTIGATION OF STARTUP OF MAGNETRON WITH COLD SECONDARY-EMISSION CATHODE AT TRAILING EDGE OF VOLTAGE PULSE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 2, Feb 84 (manuscript received 4 May 83) pp 250-256

NAUMENKO, V. D. and CHERENSHCHIKOV, S. A., Institute of Radio Physics and Electronics, Ukrainian SSR Academy of Sciences

[Abstract] The phenomenon of current excitation at the trailing edge of the voltage pulse with the cathode heater turned off is investigated in millimeter-band magnetrons with a primary secondary-emission cathode and an auxiliary lateral thermocathode employed for starting. The startup region of magnetrons with starting cathodes is investigated. The emission characteristics of the cathode with respect to startup at the trailing edge of the voltage pulse are determined. The current excitation phenomenon is not associated with microwave

generation, and can be employed in M-type and other oscillators and amplifiers. The process which leads to the appearance of current begins after the voltage across the magnetron drops below the critical cut-off voltage. Current can occur as long as the magnetic field and initial voltage are strong enough. The threshold voltage and magnetic field values can be reduced by increasing the secondary emission coefficient and the initial cathode emission. Figures 5; tables 2; references 11: 6 Russian; 5 Western (3 in Russian translation). [239-6900]

UDC 621.382.2.034.42.001.24

#### TEMPERATURE FIELD IN MOUNT OF SEMICONDUCTOR DEVICE

Moscow ELEKTRICHESTVO in Russian No 3, Mar 84 (manuscript received 12 Jan 82) pp 36-39

GORBENKO, L. I., engineer, and TUNIK, A. T., candidate of technical sciences

[Abstract] The temperature field in the mount of a semiconductor device with pellet construction, specifically a power thyristor or transistor, is calculated on the basis of the thermophysical model of a flat circular semiconductor chip at the center of the upper base of a solid cylinder made of refined oxygen-free copper. The free surface of the upper base around the chip is made adiabatic by thermal insulation. The mount is immersed in a boiling dielectric for cooling; heat is assumed to flow from chip to mount only. This model is described by the corresponding differential equation of heat conduction with appropriate boundary conditions for the normal temperature gradient at three surfaces of the mount: proportional to the thermal flux under the chip, zero under the thermal insulation, proportional to the temperature rise and to the heat transfer coefficient at the bottom. This nonlinear boundary-value problem is solved by successive approximations, because no adequate theory for an exact solution is available. The boundary condition at the bottom surface is expanded into a Taylor series and only the first two terms of the latter are retained. The steady state is selected as a first approximation, with zero net thermal flux across the body boundary according to the Green formula, and the temperature dependence of the heat transfer coefficient at the boundary with boiling coolant is approximated as  $\alpha(\vartheta) = A \vartheta^\gamma$  - excess temperature above boiling point of coolant,  $A$  - geometrical constant,  $\gamma = 2.33$  for Freon-113). Successive approximations are constructed with the aid of the Green function, in two forms for integration over the lateral surface and the base surfaces of the cylinder, respectively. An analysis of the results and comparison with experimental data reveal that already the second approximation yields the thermal resistances accurately within +6%. The results also indicate ways to optimize the mount design, its thickness not being as significant a factor as its radius. Figures 7; references 16: 13 Russian, 3 Western (all in Russian translation). [280-2415]

## LOW-FREQUENCY FLUCTUATIONS IN O-TYPE CAVITY OSCILLATORS WITH DISTRIBUTED INTERACTION

Gorkiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 4, Apr 84 (manuscript received 3 May 83, after completion 5 Oct 83)  
pp 469-480

KURBAROV, S. G. and SHMAT'KO, A. A., Kharkov State University

[Abstract] The performance of O-type cavity oscillators with distributed interaction is analyzed, specifically the effects of low-frequency noise in the electron beam on amplitude and frequency fluctuations of the generated full oscillation. Flicker noise and shot noise as well as current interception add a fluctuation component to the regular component of the electron beam current, while instability of the voltage sources and variance of initial thermal electron velocities add a fluctuation component to the initial beam velocity. Nonlinear self-consistent electron-wave interaction is described by a system of three differential equations with conventional approximations. The fluctuation process is described with regular initial conditions for beam velocity and beam phase, assuming no random premodulation of these parameters, the two equations being coupled and thus indicating an intricate mechanism of noise transformation. These equations yield the electronic efficiency and the electronic-tuning frequency shift, also two parameters characterizing, respectively, the stiffness of the limit cycle and the anisochronism of oscillations. Spectral and correlation analysis reveals a correlation between amplitude and frequency fluctuations over the entire oscillation band, instability of the initial beam velocity being their main source. The fluctuation characteristics, calculated on the basis of this analysis, depend on the intensity of the original noise components as well as on the location of the oscillator operating point within the oscillation band. The spectral densities of noise components and of oscillation fluctuations indicate that flicker noise widens the line more than does shot noise, the line becoming narrowest at the difference between velocity of the beam and phase velocity of wave which corresponds to a zero electron frequency shift and becoming diffuse toward the edges of the band. Calculations for various ratios of regular beam current to minimum starting current reveal that increasing this ratio from 2 to 6 significantly decreases the levels of amplitude and frequency fluctuations while widening the low-noise range of oscillation. Fluctuations are also smallest within the range of maximum efficiency and maximum power. The authors thank O. A. Tret'yakov for interest and helpful comments. Figures 6; references: 15 Russian.  
[279-2415]



## METHOD FOR SELECTING SINGLE-ELECTRON PHOTODETECTORS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 84  
(manuscript received 26 May 83) pp 46-48

VETOKHIN, S. S., REZNIKOV, I. V. and TIKHOMIROV, A. N.

[Abstract] A method is proposed for selecting single-electron photodetectors in which the certificate values of the anode sensitivity and results of laboratory measurements of dark current are used as the basis for the first cut. If the dark current level increases with the supply voltage more rapidly than the anode sensitivity, the device is discarded as unsuitable for operation in the single-electron mode. The final selection is made by measuring the amplitude distribution of the output pulses with supply voltage characteristic for the photodetector in question. The effectiveness of the proposed method is demonstrated by tests on FEU-64, -71, -79 and -85 photomultipliers. Tables 1; references: 10 Russian.  
[283-6900]

## FIVE-MIRROR SCANNING ASSEMBLY FOR INFRA-RED IMAGER WITH MOSAIC RADIATION DETECTOR

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 84  
(manuscript received 14 Mar 83) pp 54-56

BABAYEV, A. A.

[Abstract] A five-mirror assembly for an infra-red imager which employs a matrix radiation detector is described in which the temperature sensitivity is increased by using a mosaic radiation detector and reducing the diameter of the entrance pupil. The proposed approach makes it possible to compensate for losses in the three-mirror Dove prism by accumulating the signal. A locating element can be used to lighten the equipment by eliminating the need for a separate stabilization unit. Figures 2; references: 6 Russian.  
[283-6900]

UDC 621.9-52:007.52:519.872

SIMULATION OF MAINTENANCE PROCESS COVERING SET OF PRODUCTION MACHINERY

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 3, Mar 84 (manuscript received 2 Dec 82) pp 35-40

ZHUKOVSKIY, VLADIMIR GRIGOR'YEVICH, candidate of technical sciences, docent, and ZIMIN, VLADIMIR ALEKSANDROVICH, candidate of technical sciences, sector chief, both members of "Orbita" Public Engineering and Manufacturing Office at Novocherkassk Polytechnic Institute; CHERNOMOROV, GRIGORIY ALEKSANDROVICH, candidate of technical sciences, docent, Novocherkassk Polytechnic Institute

[Abstract] The interaction of an industrial robot with a set of production machinery in a technological plant is evaluated by simulation of the group maintenance process in accordance with the queuing theory for a group of m "storing" devices of limited capacity and one attendant. An analytical model is constructed using embedded Markov chains with only the servicing time not exponentially distributed, and using a prioritization discipline. A numerical experiment for m= 2,3,4,5 identical machines indicates that such a description of the process is correct and adequate. With given feasible probability of a requisition waiting and other known parameters of the queuing system, it is possible, on the basis of this model, to determine the maximum number of machines a robot will be able to maintain. Figures 2; references 10: 9 Russian, 1 Western (in Russian translation).  
[260-2415]

UDC 621.503.55(088.8)

PRINCIPLES OF DESIGN AND METHODS OF ANALYSIS OF CUTTING SPEED STABILIZATION SYSTEMS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 3, Mar 84 (manuscript received 15 Mar 83) pp 40-44

LOGINOV, GRIGORIY VIKENT'YEVICH, candidate of technical sciences, docent, and KUZ'MIN, ALEKSANDR VASIL'YEVICH, junior scientific associate, both of Ural Polytechnic Institute

[Abstract] Stabilization of the cutting speed thorough adjustment of the spindle speed to match changes in the cutting radius would make the machining

process much more economical, but no rational design of such a stabilization system and no method of analyzing its performance are as yet available. In this paper, the synthesis of such a system is considered, a system based on a d.c. motor with armature regulation characterized by a time constant and a damping coefficient. The automatic control system consists of a cutting speed regulator between a divider and a multiplier, with three successively broader feedback loops. Response speed and regulation error are calculated after the processes involved in cutting speed and cutting radius variation have been separated into fast and slow ones. The corresponding system of two differential equations with two variable coefficients is derived from the transfer functions and solved approximately by conversion of nonlinear second-order homogeneous equations into linear second-order nonhomogeneous ones, assuming a constant reference cutting speed and omitting the divider from the regulator structure. The transient characteristic of this system has been calculated using this method and also by the conventional method of "frozen-in" coefficients," with numerical differentiation according to the Runge-Kutta scheme on a digital computer, whereupon the sensitivity of the cutting transients to changes in parameters of the stabilization system have been evaluated. The results obtained for extreme cases (small initial cutting radius and large transverse feed per spindle revolution) indicate that the proposed method is sufficiently accurate for practical purposes and more accurate than the conventional method, while it also yields more information about changes in the cutting radius. Figures 4; references: 4 Russian.  
[260-2415]

UDC 621.314.2

#### EFFECT OF GROUP OPERATION OF PULSE CONVERTERS ON SUPPLY SOURCE

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 4, Apr 84 (manuscript received, after completion, 14 Oct 82)  
pp 62-68

BRONSHTEYN, MARK IL'ICH, junior scientific associate, and KOCHKIN, VALERIY IVANOVICH, candidate of technical sciences, sector chief, Moscow Department, Scientific Research Institute of Direct Current

[Abstract] Group operation of pulse converters controlling a semiconductor diode-bridge power circuit is analyzed from the standpoint of optimum loading of the a.c. source and optimum control, the latter being attainable through current stabilization by means of a 3-phase inductive-capacitive device. Each converter, connected between the stabilizer and the bridge circuit, consists of a transformer, a rectifier, a filter, and a d.c. switch in series. Because both a magnetizing current and a secondary current flow in the transformer, the source current is analyzed for harmonic content and corresponding ripple. Three possible schemes of converter grouping are comparatively evaluated: 1) three groups of two; 2) two groups of three; 3) one group of six. With three groups of two, the source phase currents depend on the control angle and are asymmetric. With two groups of three there is no third harmonic and its multiples, as well as no even harmonics. With one group of six converters in parallel the phase currents on the a.c. side are most nearly equal under all operating conditions, and the least stabilizer power is required. Figures 3; references: 4 Russian.  
[244-2415]

## OPTIMIZATION OF POWER ELEMENTS IN THYRISTOR INVERTERS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 4, Apr 84 (manuscript received, after completion, 14 Sep 82) pp 68-73

VESELOVSKIY, ANATOLIY PLATONOVICH, candidate of technical sciences, docent, DONSKOY, ALEKSANDR VASIL'YEVICH, doctor of technical sciences, professor, and CHERNYKH, YURIY KONSTANTINOVICH, candidate of technical sciences, senior scientific associate, all of Leningrad Polytechnic Institute

[Abstract] The problem of thyristor-type frequency converters is formulated as a problem of nonlinear programming: i.e., to minimize the inverter target function  $F(\vec{X})$  ( $\vec{X} \in E^n$  vector of  $n$  independent parameters in  $n$ -dimensional real space) under  $m$  nonlinear constraints  $g_j(\vec{X}) \geq 0$  ( $j=1, m$ ). Because of the large number of optimizable parameters, specific features of the mathematical model, and unavailability of comparative data on application of known optimization methods to this class of device, the method of random search for an unconditional extremum with either an adjustable step or a direction-dependent step is selected for solving the problem. Both search algorithms are formulated as a recurrence relation  $\vec{X}_k = \vec{X}_{k-1} + \Delta \vec{X}_k$  but  $\Delta \vec{X}_k$  is calculated differently in each. The total installed power of reactive inverter components, normalized to the average load power, is selected as the target function to be minimized, as a basis for minimization of mass and size without degradation of performance. Numerical experiments, with constraints on the  $Q$ -factor ( $0.75 \leq Q \leq 20$ ) and the frequency deviation ( $0.8 \leq \omega/\omega_0 \leq 1.2$ ) of the inductive-resistive load as well as on the performance characteristics of such an inverter with capacitive compensator and limiting diodes (response time, maximum thyristor current, maximum rate of rise of thyristor current) reveal that the speed of search according to either algorithm is almost independent of the initial conditions but search according to the algorithm with adjustable step is faster. Figures 3; references 5: 4 Russian, 1 Western (in Russian translation). [244-2415]

UDC 535.37

## FREQUENCY-CONTRAST CHARACTERISTICS OF LUMINOPHOR TRANSDUCER FOR SCANNING SILICON PHOTODETECTOR

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 84 (manuscript received 21 Apr 83) pp 12-14

LESHTAYEV, A. S.

[Abstract] The frequency-contrast characteristic of luminophor transducers is determined theoretically in order to assess performance in transmitting the image of the object under investigation and to match the optical characteristics of the transducers with those of the silicon scanning photodetectors. This

study provides the first theoretical determination of the frequency-contrast characteristic of a luminophor transducer on the photosensitive layer of a silicon photodetector. An expression is derived for the distribution of the brightness of singly-scattered luminescence radiation over the surface of the layer at the output of the luminophor transducer. The method can be used for a transducer placed directly on the photosensitive layer for protective coating of the photodetector, and when an optical system separates the transducer and the silicon photodetector. Figures 3; references 11: 10 Russian; 1 Western in Russian translation.

[283-6900]

UDC 535.853.4

SELECTION OF OPTIMUM MODULATION AMPLITUDE IN INTERFERENCE SPECTROMETER,  
SPECTRUM RECORDING A DERIVATIVE

Moscow OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 3, Mar 84  
(manuscript received 30 May 83) pp 4-6

BORISOVA, N. F. and GERSHUN, M. A.

[Abstract] The behavior of the basic parameters of the hardware function of interference spectrometers recording a derivative spectrum is analyzed as a function of the amplitude of the oscillation of the modulating element. The spectrometer is treated as having a set of hardware functions because the hardware function of the device is its response to monochromatic radiation. Derived hardware functions are computed for modulation amplitudes ranging from 0 to 1.0. The results can be used in selecting optimum modulation parameters as a function of the requirements for the hardware function of the spectrometer under various experimental conditions. Figures 2; references 5: 3 Russian; 2 Western.  
[261-6900]

UDC 681.786.3:681.785.552

PROPERTIES OF SYSTEM OF TRANSPARENT AND REFLECTING RADIAL DIFFRACTION GRATINGS  
AS AN ANGULAR MOVEMENT SENSOR

Moscow OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 3, Mar 84  
(manuscript received 23 May 83) pp 6-8

VOROB'YEV, N. N., GERASIMOV, F. M., MITINA, F. A., RASSUDOVA, G. N. and SEMENOV, I. Z.

[Abstract] The possibility of obtaining a system of transparent and reflecting radial diffraction gratings for measuring angular movement is investigated. The properties of such systems, which provide high-contrast Moire bands that are independent of the distance between the gratings and the angular dimension of the radiation source, are discussed on the basis of conclusions for linear gratings. The ratio of the intensities of the primary beams which influence

band contrast is analyzed. The phase relationships between beams with different orders of diffraction and their influence on band contrast are investigated. The fabrication and testing of some experimental radial diffraction gratings are described. Even the crude prototypes made it possible automatically to measure any angles of rotation with a precision of  $\sim 10''$  with a sufficiently large modulation percentage of the photoelectric signal by the Moire interference bands is sufficient and the distance between the gratings is not less than 1mm. It is suggested that more sophisticated gratings will make it possible to produce an effective, accurate sensor for measuring angular movements of any size. Figures 3; tables 1; references 7: 3 Russian; 4 Western.  
[261-6900]

UDC 681.3.04/05

#### METHOD FOR DETERMINING OPTIMAL PARAMETERS OF PHOTOMETRY SYSTEMS

Moscow OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 3, Mar 84  
(manuscript received 17 Jan 83) pp 9-10

CHERNOV, Ye. I.

[Abstract] A method is presented for determining the minimum noise errors provided by different types of photodetectors for different photometry system parameters (electronic measurement channel bandwidth, illumination and area of measured pixel and measured optical density). An expression is presented for the maximum noise error in systems employing photomultipliers, photodiode-operational amplifier, and avalanche photodiode-operational amplifier photometry systems. Experiments employing helogen and xenon light sources are reported. The expressions derived can be used to define the optimum parameters of photometry systems employing different types of photo detectors. Figures 2; references: 3 Russian.  
[261-6900]

UDC 531.768

#### DESIGN OF OPTIMUM MAGNET STRUCTURES FOR INDUCTIVE TACHOMETERS

Kiev TEKHNICHESKAYA ELEKTRODINAMIKA in Russian No 3, May-Jun 84  
(manuscript received 2 Jun 83) pp 25-27

SEMENOVA, SVETLANA VLADIMIROVNA, candidate of technical sciences, senior scientific-research worker, L'vov Polytechnical Institute

[Abstract] Design of the magnet structure for an inductive tachometer is treated as a unicriterial optimization problem, with one particular function being selected as the resultant target function and all others being constrained.

Accordingly, the problem is formulated as  $\psi = V_M = S_M \cdot L_M - \min(S_M, L_M) (V_M, S_M, L_M - \text{volume, cross-sectional area, and length of permanent magnet})$ . A distinctive feature of this problem is its intricate stipulation of constraints, on the basis of a mathematical model which incorporates an algorithm of initial approximation of variable parameters, results of experimental prototype tests, and a finite-difference representation of the magnetic field characteristics in the air gap. One major constraint is stipulation of minimum and maximum permissible output power. Most difficult is stipulation of the permeances of magnetic circuit components, assuming a sinusoidal distribution of the main magnetic flux and using empirical relations with piecewise-bilinear interpolation for the leakage permeance as a smooth function of  $S_M$  and  $L_M$ . The target function is not convex and, therefore, neither is the optimization problem. It is most expediently solved, in the sense of a local minimum only, by the method of gradients. A model DUS-1 tachometer for nominal speed of 3000 rpm and nominal power of 1 W with a load resistance of 2.5 kohm has been designed by this method and operates satisfactorily in several electric power plants. Figures 1; references 6: 5 Russian, 1 Western (in Russian translation). [281-2415]

UDC 621.586.772

# ERROR OF 'YEMKOSIN' CAPACITIVE ANGULAR-DISPLACEMENT TRANSDUCER CAUSED BY SKEW OF SHIELD ELECTRODE

Kiev TEKHNIЧЕСКАЯ ЭЛЕКТРОДИНАМИКА in Russian No 3, May-Jun 84  
(manuscript received 29 Jul 83) pp 83-88

GRINEVICH, FEODOSIY BORISOVICH, academician, Ukrainian SSR Academy of Sciences, head of department, Institute of Electrodynamics, Ukrainian SSR Academy of Sciences, Kiev; ZATSERKIVNYY, ZINOVIIY ALEKSEYEVICH, director, special design and technology office (SKTB), Institute of Electrodynamics, Ukrainian SSR Academy of Sciences, Kiev; LEVITSKIY, ANATOLIY STANISLAVOVICH, director sector of special design and technology office (SKTB), Institute of Electrodynamics, Ukrainian SSR Academy of Sciences, Kiev; and SURDU, MICHAIL NIKOLAYEVICH, candidate of technical sciences, group leader, Institute of Electrodynamics, Ukrainian SSR Academy of Sciences, Kiev

[Abstract] The capacitive angular-displacement transducer "Yemkosin" was developed at the Institute of Electrodynamics (UkSSR Academy of Sciences), jointly with the Special Engineering and Manufacturing Office, for measurement of angles over the entire 0-360° range and either displaying or encoding the readout. It consists of two parallel disks, a current electrode and a potential electrode, with a shield electrode between them equidistant from both and nominally parallel to them. A major source of transducer reading error is the skew of the shield electrode, a result of manufacturing imprecision. This error is analyzed here, assuming that the center of the shield electrode and the center of the current electrode lie on a common axis, the current electrode and the potential electrode are perfectly parallel, the current sheet on the shield electrode is infinitesimally thin, all sectors of the current electrode are equal, and all windows in the shield electrode are spaced uniformly around



a circle. The angle reading of the transducer is proportional to the ratio of difference to sum of the two capacitances in such a variable-area differential capacitor. Both capacitances are functions of geometrical dimensions, including sector angles and displacement angle. They are calculated first for the ideal case with the shield electrode parallel to the others and then with the shield electrode rotated about its diameter through some angle to its nominal position. In the latter case there appears an increment of effective capacitor area, with outer and inner circles projecting as ellipses in a plane parallel to the electrodes and as right triangles in a plane perpendicular to them. The established trigonometric relations reveal that, with at least two windows in the shield electrode, a small skew of the latter does not produce an error. With only one window in the shield electrode, the error is proportional to the skew angle squared but remains relatively small even at relatively large skew angles. Figures 4; references: 8 Russian.  
[281-2415]

UDC 621.317.421

#### METROLOGICAL EQUIPMENT SET FOR DUPLICATION OF VARYING MAGNETIC FIELD

Kiev TEKHNIЧЕСКАЯ ЭЛЕКТРОДИНАМИКА in Russian No 3, May-Jun 84  
(manuscript received 23 May 83) pp 88-91

BRAYKO, VOL'DMIR VASIL'YEVICH, candidate of technical sciences, head of laboratory, Institute of Electrodynamics, Ukrainian SSR Academy of Sciences, Kiev; TARANOV, SERGEY GLEBOVICH, doctor of technical sciences, head of department, Institute of Electrodynamics, Ukrainian SSR Academy of Sciences, Kiev; and TERESHCHENKO, NIKOLAY FEDOROVICH, candidate of technical sciences, head of department, special design and technology office (SKTB), Institute of Electrodynamics, Ukrainian SSR Academy of Sciences, Kiev

[Abstract] A universal metrological set has been developed for discrete duplication of varying magnetic fields, with sinusoidal, exponential, trapezoidal, and sawtooth segments, to serve as an aid in design of precision sources of a magnetic field for inspection of magnetic-type measuring instruments. It is based on an "Elektronika-60M" microcomputer with a digital-to-analog converter as interface, an alphanumeric printer, a display panel, and an XY-plotter. The converter is coupled to a controllable direct-current source, a current-stabilized multistage transistor power amplifier, which feeds an induction standard through a negative current-feedback loop. Both are also connected to respective inputs of a comparator whose output is connected to a corrective network sending a signal to a summing circuit. The microcomputer is connected to a source of test signals feeding the induction standard and to a device measuring the time constant of that induction standard. The induction standard is a Helmholtz coil capable of highly uniform duplication of magnetic fields, connected to a resistance and inductance monitoring device as well as to a temperature monitoring device. The set operates in four modes: 1) in the "check 1" mode single or periodically repetitive magnetic field pulses are generated precisely matching prescribed parameters; 2) in the "check 2" mode a

given field variation curve is approximated with exponential steps of required precision; 3) in the "calibrate" mode the parameters of the induction standard are determined from test signals and compared with their permissible limits; 4) in the "simulate" mode the required law of duplication is selected from an available program bank. The set can duplicate almost any sequence of single pulses or periodic pulse trains and approximate most intricate field patterns, with a 1 mT field resolution and a 1  $\mu$ s time resolution. Its field range is 1-100 mT, its frequency range is 1-1000 Hz, and its basic error is 0.1%. Figures 2; tables 1; references: 2 Russian. [281-2415]

UDC 535.39.01

#### INFLUENCE OF ERRORS OF ELLIPSOMETRIC EQUIPMENT ON MEASUREMENT ACCURACY IN ONE ZONE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 84 (manuscript received 28 Apr 83) pp 4-7

BENDERE, R. B., KALNYNYA, R. P., FELTYN'SH, I. A. and FREYVALDE, I. R.

[Abstract] A method is presented which permits experimental data to be used in order to select the calculation of zone corrections in measurements of ellipsometric parameters which best correspond to the theory. The calculated functional relationships of the correction values are compared with experimental results over a wide range of variation in the extinction position. An expression is derived for finding the ellipsometric parameters  $\Delta$  and  $\psi$  and the measured extension positions of the prisms of the polarizing filter and analyzer in separate zones. The behavior of the zone corrections is experimentally investigated on an LEF-2 laser ellipsometer. The good agreement between the experimental values and the graduated curves confirms that the method can be used to find the correction values. Figures 3; tables 2; references 8: 2 Russian, 6 Western. [283-6900]

UDC 681.782

#### ESTIMATION OF CONTRAST OF SINGLE-BAND IMAGES IN OPTICAL OBSERVATIONAL SYSTEM

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 84 (manuscript received 30 Jun 83) pp 17-19

DUBENSKOV, V. P. and VASIL'YEV, V. Ya.

[Abstract] The contrast of the image of a single-band under varying illumination conditions perceived with the help of an optical instrument is estimated by analyzing the illumination distribution in the image of a thin line in order to explain the ability, under certain conditions, to discriminate instrumentally

or with the unaided eye objects with transverse size far smaller than the maximum resolution of the device or the eye, such as wires against a bright sky. The illumination distributions in the image of a light b and with width h are tabulated for different distances from the geometric center. The table can be used to establish the minimum distance between the edges of two adjacent bands with the same brightness for which the illumination distributions in the image have practically little or no influence on one another. It is found that the contrast of the image of bands in an optical instrument, as well as their visibility, are determined by the size of the scattering circle in the optical system, the form of the illumination distribution curve within the circle, the amount of contrast of the object, and whether the object is lighter or darker than the surrounding background. Figures 3; tables 3; references: 7 Russian.  
[283-6900]

UDC 621.317:621.397.13

#### NEW SIGNAL-TO-NOISE RATIO METERS

Moscow TEKHNICA KINO I TELEVIDENIYA in Russian No 4, Apr 84 pp 44-45

VILENCHIK, L. S., DEVYATOVSKIY, V. G., DEMIN, B. B., ZVEREV, Yu. B., KRIVOSHEYEV, M. I., MAREYN, R. L. and TRET'YAK, S. A., State Scientific-Research Institute for Radio; All-Union Scientific-Research Institute for Television and Radio Broadcasting

[Abstract] The performance of two commercially produced signal-to-noise ratio meters--The ISSh-4M and ISSh-6--is compared. The ISSh-4M is comparatively slow because the television signal and noise mixture is digitized at the frame frequency. The ISSh-6 meter operates twice as fast. The operating principles of both devices are discussed, and structural diagrams are analyzed. Each device has a 20-65 dB range, with measurement error not exceeding 1dB. The measurement cycle time for the ISSh-4M is 50 seconds, and that of the ISSh-6 is 25 seconds. The calibration procedure for each device is explained. Figures 3; references: 5 Russian.  
[240-6900]

#### "ELEKTRONIKA B3-21" EXAMINER DEVICE

Moscow RADIO in Russian No 5, May 84 pp 24-25

BARANOV, A., Kyshtym, Chelyabinsk Oblast

[Abstract] Use of an "Elektronika B3-21" programmable microcalculator for classroom testing of student performance in making measurements and other calculations is described. Programming of the calculator for testing different numbers of students is explained. The calculator provides a convenient testing device which has a self-contained power source and is portable, permitting it to be used at the blackboard, at classroom stations, in the laboratory and in the field. Tables 4.  
[245-6900]

## OPTIMIZATION OF AUTOMATIC CONTROL SYSTEM FOR ELECTROMAGNETIC SUSPENSION BY METHOD OF PLANNED EXPERIMENT

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 3, Mar 84 (manuscript received 28 Jan 82, after completion 17 Feb 82) pp 50-54

REZHKO, NIKOLAY ALEKSEYEVICH, senior scientific associate, VELNII (All-Union Scientific Research, Design, Planning and Technological Institute of Electric Locomotive Construction), Novocherkassk; SAVIN, MIKHAIL MIKHAYLOVICH, candidate of technical sciences, docent, TROFIMENKO, VLADIMIR GRIGOR'YEVICH, candidate of technical sciences, senior instructor, and PYATINA, OL'GA NIKOLAYEVNA, candidate of technical sciences, docent, from Novocherkassk Polytechnic Institute

[Abstract] The problem of optimizing an automatic control system for an electromagnetic suspension is treated as a problem of parametric synthesis. A planned experiment is the most expedient method of solution. An analytical solution is too intricate and linearized models are only applicable to small excursions from the steady state. The optimality criterion is simplified appropriately in the form of a better quadratic estimate  $J = \int_0^T [\delta^2 + \tau^2 (\frac{d\delta}{dt})^2]$

dt ( $\delta$  - gap width between armature and electromagnet core,  $\tau$  - time constant of pulling action), assuming  $\delta(t) = \delta_0 e^{-t/\tau}$  and letting  $J_{\min} = C - y_{\max}$  ( $C$  - constant component determined by analog computing network,  $y_{\max}$  - maximum value of optimizable parameter determined from experiment). A 2-factorial 3-level experiment is designed, with ranges of variation defined for both factors, whereupon a regression equation is constructed on the basis of nine numerical tests. Because of the orthogonality of the plan, all coefficients in this equation can be calculated independently. The adequacy of this equation and the significance of its coefficients have been verified by Cochran's, Fisher's, and Student's tests. Figures 4; tables 1; references: 2 Russian. [260-2415]

## ELECTRODYNAMIC CHARACTERISTICS OF SOLID-STATE CURRENT PICKUP IN SUPERCONDUCTOR-TYPE HOMOPOLAR ELECTRIC MACHINES

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 3, Mar 84 (manuscript received 25 Nov 82, after completion 5 Nov 83) pp 54-58

ZABOIN, VALERIY NIKOLAYEVICH, candidate of technical sciences, assistant, IVANOV, SERGEY NIKOLAYEVICH, graduate student, KULAKOV, VLADIMIR ALEKSANDROVICH, junior scientific associate, and ROMANOV, VASILY VASIL'YEVICH, doctor of technical sciences, professor, all of Leningrad Polytechnic Institute

[Abstract] The design of a solid-state current pickup for superconductor-type homopolar d.c. machines is analyzed from the standpoint of forces acting on the brush. Interaction of the magnetic field, its axial and radial components, with the armature current generates electrodynamic forces which can destabilize the contact and cause brush vibrations while contributing to higher electrical and mechanical losses. A lateral brush displacement against the holder will result in additional friction. The dependence of the tangential electrodynamic force on the brush length and of both axial and normal electrodynamic forces on the brush thickness are calculated on the basis of Ampere's law, assuming an infinitesimally thin current filament whose length is determined by the brush geometry. Numerical calculations and experimental data for a machine with  $I = 100$  A,  $B_R = 2$  T and  $B_z = 3$  T (respectively, radial and axial components of magnetic induction within the brush zone) indicate that the approximation of a current filament rather than current sheet remains valid even for wide and thick brushes. However, the real contact area is smaller than the apparent contact area (brush width x brush thickness), and becomes a smaller fraction of the latter as the brush dimensions increase, so that assuming a definite small difference between them is sufficiently accurate only for brushes whose width and thickness do not exceed 10 cm. Figures 4; references 4: 3 Russian, 1 Western.  
[260-2415]

UDC 532.593+537.84

## BREAKDOWN OF LIQUID-METAL FILMS IN ELECTROMAGNETIC FIELD

Kiev TEKHNIЧЕСКАЯ ELEKTRODINAMIKA in Russian No 3, May-Jun 84 (manuscript received 17 Feb 83) pp 16-20

KAZACHKOV, IVAN VASIL'YEVICH, candidate of Physico-Mathematical Sciences, junior research worker, Institute of Cybernetics, Ukrainian SSR Academy of Sciences, Kiev; and KOLESNICHENKO, ANATOLIY FEDOROVICH, candidate of technical sciences, head of department, Institute of Electrodynamics, Ukrainian SSR Academy of Sciences, Kiev

[Abstract] A horizontal liquid-metal film of given thickness has been formed by a jet of melt fanning out uniformly in all directions upon vertical downward discharge from an orifice in the crucible. Breakdown of this film is facilitated

by the electromagnetic field of two coaxial identical horizontal closed circular conductors, one underneath the film and one above the film around the jet. Each conductor passes through a tunnel of uniformly spaced thin horseshoe magnets. The period of both circular magnet arrays is equal to the circumferential wavelength on the free film surface and the width of both circular conductors is equal to the radial wavelength on the free film surface. The currents induced in the two conductors flow in the same direction. The problem of film stability and breakdown is treated as a problem of magnetohydrodynamics. The equations of magnetic field diffusion in the metal are formulated accordingly, observing the condition of solenoidality and disregarding the emf generated by wave motion of the perturbed film. The corresponding boundary-value problem is solved for eigenvalues with negative real part, corresponding to breakdown. The relations simplify for a thin film. They yield the parameters of a perturbing electromagnetic field, including its frequency, which will break down a liquid-metal film and also the diameter of drops into which it will be broken down. Figures 1; references 5: 4 Russian, 1 Western (in Russian translation).

[281-2415]

## MICROWAVE THEORY AND TECHNIQUES

### PHOTODIODE BASED OPTRONS AND OPTRON MICROCIRCUITS

Moscow RADIO in Russian No 1, Jan 84 pp 59-62

YUSHIN, A.

[Abstract] This article, the first installment of a two-part article, tabulates the basic parameters and specifications of optron microcircuits, diode optrons, multichannel diode optrons, diode-transistor optrons and diode differential optrons, including electrical parameters and maximum permissible operating modes. Figures 6.  
[216-6900]

UDC 621.372.828

### WEAKLY LOCALIZED WAVES IN STRIPLINES

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 2, Feb 84 (manuscript received 1 Apr 83) pp 224-231

GUREVICH, G. L., LYUBIMOV, V. V. and OTMAKHOV, Yu. A.

[Abstract] It is demonstrated that the field of the primary wave is localized in the cross section in an area roughly equal to the height of the line, only when the dielectric and magnetic permeability of the media filling the space above and below the strip are the same (for a symmetrical line), or when the permeability of one of the media is far greater than that of the other (for asymmetrical line). The scale of transverse field localization for intermediate ratios of the permeability may significantly exceed the height of the line, and the wave may become radiating under certain conditions. The theoretical findings are confirmed by experimental measurements of the coupling between two widely separated striplines on a ferrite substrate. The authors thank V. V. Nikol'skiy, A. V. Druzhinin, A. M. Lerer, V. S. Mikhalevskiy and S. M. Tsvetkovskiy for the opportunity to use their program. Figures 5; references 10: 9 Russian; 1 Western (in Russian translation).  
[239-6900]

# BACKSCATTERING AMPLIFICATION EFFECT OF WAVES ON BODY IN REGULAR MULTI-MODE WAVEGUIDE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 3, Mar 84 (manuscript received 11 May 83) pp 319-323

AKHUNOV, Kh. G., KRAVTSOV, Yu. A. and KUZ'KIN, V. M., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] The region of the amplification effect of backscattering on a body in a regular multimode waveguide is found with the help of mode description; the contribution of the focusing effect is identified. The amplification effect is caused by the fact that the scattering from the M-mode to the Mu-mode is the same as the reverse scattering when the receiver is next to the source. The dimensions of the region within which the amplification effect occurs are found. It is noted that backscattering amplification also occurs for extended scatterers. Figures 1; references 7: 6 Russian; 1 Western (in Russian translation).  
[204-6900]

# ELECTROMAGNETIC WAVE PROPAGATION IN PLANAR WAVEGUIDES WITH IRREGULAR BOUNDARIES (SURFACE ADMITTANCE METHOD)

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 3, Mar 84 (manuscript received 10 Nov 82) pp 363-372

BIRYUKOV, S. V.

[Abstract] The scattering of surface waves on boundary irregularities, as well as the propagation of these waves in periodic structures and film-profile waveguides, are examined as an illustration of the use of the surface admittance tensor, which relates the tangential components of the electrical and magnetic fields at the boundary of the internal region, in investigating surface wave propagation in planar waveguides. It is found that this approach often makes it possible to obtain valid results without specifying the admittances of the external space, because effects associated with the structure of the layered medium and with heterogeneity parameters are easily separated. The author thanks S. M. Rytov for a discussion of the results of the work. References 10: 8 Russian; 2 Western (in Russian translation).  
[204-6900]



## SURFACE ADMITTANCE METHOD IN THEORY OF PLANAR OPTICAL WAVEGUIDES

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 3, Mar 84 (manuscript received 10 Nov 82) pp 373-382

POLEVOY, V. G.

[Abstract] The surface admittance method is used to examine wave propagation in planar optical waveguides. The determination of surface admittance and certain of its properties are analyzed, and an equation is derived for surface admittance. Energy relationships for surface waves propagating in a transversely homogeneous medium are obtained through the surface admittance. The use of surface admittance is found to provide general, compact expressions for all of the quantities relating to surface waves. The author thanks S. M. Rytov for discussing the results of the work. References 7: 5 Russian; 2 Western (in Russian translation).  
[204-6900]

## QUASI-SENSORY SWITCHES EMPLOYING MICROCIRCUITS

Moscow RADIO in Russian No 3, Mar 84 pp 26-29

ALEKSEYEV, S., Moscow

[Abstract] Electronic switches which employ digital microcircuits and are controlled by a mechanical context of pushbutton switches are examined. The influence of contact chatter on switching reliability is eliminated by using static flip-flops and pushbuttons with switching contacts. Schematic diagrams for eight different electronic switching arrangements are traced and explained. Figures 7.  
[211-6900]

## EMPLOYMENT OF K176 SERIES MICROCIRCUITS

Moscow RADIO in Russian No 5, May 84 pp 36-40

ALEKSEYEV, S.

[Abstract] This is the second installment of a three-part article on K176 microcircuits. The operating parameters of thirteen different microcircuits in this series are presented, along with descriptions of their connections to various transisto-transisto logic and other circuits. The concluding installment of the article is to be published in a future issue of RADIO. Figures 5.  
[245-6900]

PROTECTIVE AUTOMATION AND COMPLEX FAULT PROCESSES IN ELECTRIC POWER SYSTEMS

Moscow ELEKTRICHESTVO in Russian No 3, Mar 84 (manuscript received 31 Aug 83)  
pp 13-18

IOF'YEV, B. I., Moscow

[Abstract] The role of protective automation in large electric power systems is analyzed from the standpoint of reliability, viability, and stability assurance. Important considerations are also qualitative characteristics of generated and distributed energy along with energy economy and conservation, as well as adequate normal and overload capacity. Faults in interconnected systems always result from combinations of accidental events so that automatic fault clearance or fault prevention must be based on an analysis of random processes and on a probabilistic model of interaction between system components. The basic and simplest model is that of two equivalent generators, each with a load network and with a tie between them. Typical tasks of automatic control are to ensure maintenance of stability and compensation of reactive power. The stochastic nature of faults and protective actions introduces the element of error, minimization of which is another important requirement in automation. The need for an the effectiveness of automation depend on the intensity and the frequency of perturbations as well as on the stiffness of the normal operating mode, while the scope of automation depends largely on the strength of interconnections. Weak interconnections with small overload margin require automatic fast clearance of asynchronism rather than automatic fault prevention. Strong interconnections are characterized by rare but very dangerous destabilizing perturbations, automatic protection against which still presents a technically and economically unresolved problem. Interconnections in the intermediate range are the area of extensive and broad applications for various forms of protective automation. Figures 2; tables 1. [280-2415]

## MATHEMATICAL MODEL OF A.C. GROUNDING DEVICE

Moscow ELEKTRICHESTVO in Russian No 3, Mar 84 (manuscript received 25 Aug 82)  
pp 25-30

PUCHKOV, G. G.

[Abstract] A mathematical model of a grounding device is proposed as a basis for calculating the electromagnetic field of such a device, an important factor in design and control of electric power distribution systems. Unlike the method of induced potentials, this model covers a frequency range rather than only the nominal system frequency and takes into account the field lag as well as the extraneous field. The grounding device is described by two systems of integro-differential equations with respect to the longitudinal space coordinate, one for the potentials and one for the longitudinal potential gradients. Transverse internal resistances and internal as well as external longitudinal impedances, respectively, are multiplied under the integral sign by transverse currents and the differential linear density of transverse currents, unlike in the electrostatic model for the transverse circuit parameters and with the edge effect included for the longitudinal circuit parameters. For illustration, the two systems of equations are solved for a horizontal grounding grid with linear longitudinal potential profile. Algorithms have been devised for two methods of solution. The iterative solution by approximation and correction applies to a narrow frequency range but allows for a large number of grid elements. The analytical solution applies to a wide frequency range and also to short-circuit conditions, taking into account the increase of reactance and phase angle, eventually also of resistance, as well as a departure from equipotentiality as the frequency increases. Figures 2; tables 3; references: 7 Russian.  
[280-2415]

## EXPERIMENTAL STUDIES CONCERNING DEPENDENCE OF DISCHARGE VOLTAGES ACROSS WIDE AIR GAPS ON AIR HUMIDITY

Moscow ELEKTRICHESTVO in Russian No 3, Mar 84 (manuscript received 2 Aug 83)  
pp 45-48

RUDAKOVA, V. M., candidate of technical sciences, Scientific-Research Institute of Direct Current

[Abstract] An experimental study of air gaps in substations was made, for the purpose of determining the dependence of their electric strength and discharge characteristics on the absolute humidity of ambient air. Actual gaps were simulated in two configurations: 1) 3, 5, 7 m-wide gaps between a guard ring and a grounded pedestal; 2) 3.1 m-wide gap between two guard rings. In the first configuration the two wider gaps were formed with the guard ring suspended

from a V-bushing insulator. Discharges across the gaps were produced by means of a 3x750 kV bank of switching pulse transformers, all pulses of positive polarity with a 3500  $\mu$ s rise time. The discharge characteristics were evaluated in terms of the dependence of the flashover probability on the amplitude of the applied voltage, with the standard definition of discharge voltage as the voltage causing discharge in at least 50% of all tests. The standard deviation and the variability factor in determining the discharge voltage on the basis of 120-160 discharge events at each level were 1-1.5% and 15-30%, respectively. A chi-square test has revealed that the distribution of the discharge voltage is not a normal one, the small standard deviation confirming that temperature-related variations and humidity-related variations compensate each other to a large extent. The humidity dependence of the discharge voltage in air with a 0.98-1.02 standard density was found to be non-linear, the voltage increasing rapidly over the 0-8 g/m<sup>3</sup> range and slowly over the 8-16 g/m<sup>3</sup> range. A second-degree regression equation has been obtained for the entire 0-16 g/m<sup>3</sup> range and its coefficients calculated, as well as the corresponding correlation coefficients for each configuration and gap width. Figures 5; tables 3; references 5: 1 Russian, 4 Western.  
[280-2415]

UDC 621.373.001.24

#### DESIGN OF HELICAL SURGE GENERATOR

Moscow ELEKTRICHESTVO in Russian No 3, Mar 84 (manuscript received 29 Mar 83)  
pp 56-58

AVRUTSKIY, V. A., LEVITOVA, L. V. and NAYMARK, G. V., Moscow Institute of Power Engineering

[Abstract] Calculations for a helical surge generator, after the relation between performance characteristics and design parameters has been established, involve an evaluation of many variants with not only one parameter changed each time but with several parameters changed simultaneously. An additional factor contributing to the enormity of the design optimization problem is the fact that coils can be wound on a closed or open iron core, or without an iron core. Here the earlier analysis on the basis of an equivalent circuit with lumped parameters is modified so as to take into account the load capacitance and to refine the losses in stripline conductors in the calculation of the output voltage. The new expression for the latter only applied to either a closed core or to a coreless winding, however, and for the very practical case of an open core it becomes necessary to introduce a correction which accounts for the air gap in addition to the correction which accounts for the relative shortness of the solenoid. On this basis the winding utilization factor can then be calculated, which should be higher than 0.5, and the significant first pulse peak. Calculations are shown for a 500 kV generator with only the secondary resistance, the number of secondary turns, and the gap width as variable design parameters. A utilization factor of 0.87 is theoretically attainable in this case, but is only 0.72 according to experimental verification. Figures 1; references: 2 Russian.  
[280-2415]

## PROTECTION OF THYRISTORS FROM SWITCHING SURGES IN MAGNETO-THYRISTOR PULSE GENERATORS

Moscow ELEKTRICHESTVO in Russian No 3, Mar 84 (manuscript received 12 Jun 82)  
pp 58-60

POLYAKOV, N. P. and SINENKO, V. V., Tomsk Polytechnic Institute

[Abstract] The problem of protecting thyristors in magnetic-type pulse generators against post-switching surges is analyzed from the standpoint of the requirements for a high pulse-repetition rate. The reverse voltage is calculated in a thyristor bridge across the commutating capacitor used for this purpose, in series behind a saturable choke. It is considered that the choke takes up the total voltage when it is unsaturated. The condition for effectiveness of such a protection is that the magnetization reversal charge for the choke be much smaller than the recovery charge for the thyristors and, consequently, the latter do not recover their turn-off capability during the reverse-voltage period. This is confirmed by oscillograms. A comparative evaluation of this method of protection and protection by means of an RC smoothing filter reveals that the energy losses are reduced and lower-grade thyristors can be used with a saturable choke. Figures 6; references: 4 Russian.  
[280-2415]

## APA-5D AIRPORT ELECTRIC GENERATOR-MOTOR SET

Kiev TEKHNIЧЕСКАЯ ELEKTRODINAMIKA in Russian No 2, Mar-Apr 84 pp 3-4

YUDIN, KIRILL MIKHAYLOVICH, candidate of technical sciences, dotsent Kiev Polytechnical Institute; and DROBYAZKO, SEVERIN FEDOROVICH, candidate of technical sciences, professor, Kiev Polytechnical Institute

[Abstract] A transportable generator-motor set for single or group starting of aircraft engines has been developed at the Department of Electric Drives and Industrial Equipment Automation of the Kiev Polytechnical Institute. It is already produced commercially at the "Avtoelektroprivod" plant. This APA-5D set supplies direct current at 28.5 V as well as 3-phase 400 Hz alternating current at 208 V or 37 V and single-phase 400 Hz alternating current at 120 V with frequency stabilization. The set is mounted on a "Ural-4320" diesel truck, driven by the same 154 kW engine. The set is designed to operate reliably with maximum fuel economy; it does not require large and heavy floating storage batteries. Starting and load changes are monitored and controlled through special circuitry. A special cable feeding device facilitates easy and fast servicing of airplanes on ground. Figures 1.  
[262-2415]

## ELECTROMAGNETIC COMPATIBILITY IN 3-PHASE SYSTEMS WITH RECTIFIER LOADS

Kiev TEKHNIЧЕСКАЯ ЭЛЕКТРОДИНАМИКА in Russian No 2, Mar-Apr 84  
(manuscript received 9 Aug 83) pp 8-17

SHIDLOVSKIY, ANATOLIY KORNEYEVICH, corresponding member, Ukrainian SSR Academy of Sciences, director institute of electrodynamics, Ukrainian SSR Academy of Sciences, Kiev; MOSTOVYAK, IVAN VASIL'YEVICH, candidate of technical sciences, assistant director of institute of dynamics, Ukrainian SSR Academy of Sciences, Kiev; MOSKALENKO, GEORGIY AFANAS'YEVICH, candidate of technical sciences, scientific worker, institute of electrodynamics, Ukrainian SSR Academy of Sciences, Kiev; and NOVSKIY, VLADIMIR ALEKSANDROVICH, junior scientific worker, institute of electrodynamics, Ukrainian SSR Academy of Sciences, Kiev

[Abstract] Electromagnetic compatibility in 3-phase power distribution systems with converting equipment, specifically rectifiers or other generally nonlinear rapidly-varying nonsteady loads, is considered and a new method is proposed for fast stabilization of the energy quality indicators. The method is explained for a delta network with a resistance in series with two opposing thyristors in parallel loading one phase. A variable inductance and a variable capacitance close the delta load. Complete sinusoidality and symmetry of the three line currents can be ensured by appropriate variation of both inductance as functions of time. Calculations are based on Kirchhoff's circuital laws, voltage-current-time relations in both energy storing elements, and appropriate use of Fourier series representation. The method can be extended to compensation of reactive power and reduction of voltage ripple. Figures 4; references: 8 Russian.  
[262-2415]

## NOMOGRAM FOR DETERMINING VOLTAGE AND CURRENT ASYMMETRY IN TRANSFORMED COORDINATES

Kiev TEKHNIЧЕСКАЯ ЭЛЕКТРОДИНАМИКА in Russian No 2, Mar-Apr 84  
(manuscript received 24 Nov 82) pp 33-37

MAYER, VIKTOR YAKOVLEVICH, candidate of technical sciences, dotsent, Zaporozhskiy Polytechnical Institute; POLUKAROV, NIKOLAY IVANOVICH, engineer, Kuybyshev Subway-Building Organization (METROSTROYA); and KLIMENKO, VLADIMIR FEDOROVICH, chief engineer of plant

[Abstract] The special nomogram constructed at the Kuybyshev Polytechnic Institute, along with table of symmetric components, for determination of voltage and current asymmetry in 3-phase systems is not sufficiently accurate in the 5-10% range and not sufficiently resolvable below 5%. Another nomogram designed for small asymmetry factors not exceeding is inadequate for reading voltage and current asymmetry of 2-3%. A new nomogram minimizes the reading error over the entire range by a transformation of coordinates  $x_1' = \sqrt[3]{\ln x_1}$

and  $y_i' = \sqrt[2]{\ln y_i}$  ( $x_i' = V_{CA}/V_{AB}$  and  $y_i' = V_{BC}/V_{AB}$  in the scales of the old system of coordinates), with directions of the negative-sequence voltage vector as reference. As a result, the upper right-hand part of the lower left-hand part of the nomogram are respectively compressed and expanded, which almost completely eliminates the dependence of asymmetry readings on the magnitude of the asymmetry factor. Each plotted value of the voltage or current asymmetry factor is

$$K = 100 \sqrt{\frac{A^2 + B^2 + C^2 - \sqrt{3(A+B+C)(B+C-A)(C+A-B)(A+B-C)}}{A^2 + B^2 + C^2 + \sqrt{3(A+B+C)(B+C-A)(C+A-B)(A+B-C)}}$$

(A, B, C - moduli of the three line voltages or currents). Calculations were made with the use of tables and reduction to pure quadratic and biquadratic equations. Figures 1; references: 5 Russian.  
[262-2415]

UDC 621.314.11

#### POWER RELATIONS IN CONVERTER CIRCUITS WITH SERIES-PARALLEL CONNECTION OF TRANSISTORS

Kiev TEKHNIЧЕСКАЯ ELEKTRODINAMIKA in Russian No 2, Mar-Apr 84  
(manuscript received 10 Jun 83) pp 58-63

DUPLIN, NIKOLAY IL'ICH, candidate of technical sciences, Ryazansk Radio Engineering Institute

[Abstract] Converters with transistor input stages in series and outputs in parallel have excellent performance characteristics, especially when connected to regulators with adaptive structure. A typical simple device of this kind consists of two push-pull stages. Current and voltage processes in this device acting as a voltage stabilizer are analyzed here for the general case of unequal to input capacitances and unequal to output inductances, conditions under which group failures are likely to occur. The analysis is based on a half-period equivalent circuit with two capacitances in series across an emf, each capacitor shunted through a switch by a diode and by a choke in series with a voltage dropping load. The two switches representing transistors act nominally in synchronism. Calculations are based on Kirchoff's circuital laws for instantaneous currents and voltages respectively, the latter differentiated with respect to time. A relation is obtained for the time interval within which the currents in the two equivalent output loops become equal after closing of the switches. This relation reveals that sufficiently large input capacitances are necessary for avoiding an appreciably unequal division of voltage between input stages with eventual momentary appearance of the total voltage across one of them. Figures 4; references: 2 Russian.  
[262-2415]



# COMPREHENSIVE SYSTEM OF MAIN CHARACTERISTICS OF SEMICONDUCTOR POWER DEVICES, PART 1: ELECTRICAL ENGINEERING CHARACTERISTICS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 3, Mar 84 (manuscript received 16 Jun 82, after completion 19 May 83) pp 81-91

BONDARENKO, NIKOLAY NIKIFOROVICH, candidate of technical sciences, docent, Mordovo State University, and BRATOLYUBOV, VSEVOLOD BORISOVICH, candidate of technical sciences, sector chief, All-Union Institute of Electrical Engineering imeni V. I. Lenin, Moscow

[Abstract] In order to use semiconductor devices in power converting equipment most effectively, as well as to improve their technical and economic indicators, it is necessary first to establish the relations between their engineering-physical and design-technological characteristics. The electrical engineering characteristics are defined first, as part of a comprehensive system, the principal feature of this group being its isothermality or synchronism with respect to heating. Temperature serves accordingly as their basic common reference, inasmuch as it is the dominant state variable. Firing angle is the second one. These characteristics are current-temperature and voltage-temperature load characteristics, followed by current-voltage external characteristics with the current as a function of temperature and firing angle and the voltage as a function of current and firing angle, power output characteristics, and usability characteristics. The usability function is the product of current and mean time between failures with each a function of temperature and firing angle, or it is the product of power and mean time between failures with each a function of current and firing angle. Equations defining these characteristics and curves describing them are given, along with numerical data indicating actual and potential capability limits of such devices in various converter circuit configurations. Figures 5; tables 2; references: 15 Russian. [260-2415]

UDC 621.316.726:629.12.066

## SYNTHESIS OF OPTIMUM SPEED REGULATORS FOR SHIP DIESEL-GENERATORS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 4, Apr 84 (manuscript received 13 Jan 82) pp 48-52

VERESHCHAGO, EVGENIY NIKOLAYEVICH, senior engineer, Nikolayev Institute of Ship Building

[Abstract] An optimum speed regulator for ship diesel-generators is synthesized by the known analytical engineering method. The system structure and the control are determined through minimization of a functional which represents the given performance optimality criterion. Both diesel engine and servomotor are described in the first approximation by a canonical system of two differential equations in increments, with corresponding two time constants. Minimization



of the integral functional involves satisfying the corresponding system of Euler-Poisson equations. The characteristic algebraic equation reduces to an even polynomial, which degenerates asymptotically to a biquadratic one. The transfer function of the resulting regulator is realizable, and the system closed by such a regulator is "roughly" optimum in the Andronov sense as long as deviations of its actual parameters from their design values remain small. A numerical example illustrates the procedure. A regulator for a typical prime mover (diesel-generator) with given transient period, overshoot, and static stabilization error under a given external perturbation has been built with series 140 and 155 integrated microcircuit chips. It contains a phase detector with a loop characteristic, which eliminates self-excited oscillations of first and second kinds while widening the pull-in range all the way to the pull-out limit. This regulator was tested on a diesel engine after a sudden application and after a sudden removal of the full load. Figures 2; references: 7 Russian. [244-2415]

UDC 621.373.826

EFFICIENCY OF ADAPTIVE OPTICAL SYSTEMS UNDER TURBULENT ATMOSPHERIC CONDITIONS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 3, Mar 84 (manuscript received 18 Apr 83) pp 284-293

VORONTOSOV, M. A., KORYABIN, A. V. and SHMAL'GAUZEN, V. I., Moscow State University

[Abstract] The efficiency of adaptive optical systems is estimated on the basis of an interference criterion in order to allow receiving as well as transmitting optical systems to be analyzed from the same viewpoint. It is demonstrated that the Strehl number, the signal-to-noise ratio in amplitude- and phase- frequency modulated optical communication systems, and the operating performance of adaptive interferometers are expressed through the Strehl number. The calculations are performed for systems employing a modal wavefront corrector. The findings can be used to analyze segmented correctors and systems which combine modal and zonal correction of the wavefront under turbulent atmospheric conditions. Aspects of corrector optimization are discussed. It is found that the use of multi-stage correction circuits makes it possible to reduce the total number of drives by more than an order of magnitude. Figures 7; tables 2; references 14: 8 Russian; 6 Western.  
[204-6900]

UDC 621.373.826.038.825.5

EQUIVALENT-CIRCUIT PARAMETERS OF HETEROJUNCTION LASERS AT CURRENTS BELOW THRESHOLD

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 4, Apr 84 (manuscript received 1 Nov 82, final variation received 1 Apr 83) pp 441-449

KARIKH, Ye. D. and SHILOV, A. F., Belorussian State University

[Abstract] The equivalent-circuit parameters of an AlGaAs injection laser operating in the spontaneous-emission mode at a low forward bias and currents below the threshold level are calculated on the basis of theoretical relations and experimental data. Taken into account are drift and diffusion of excess

charge carriers, recombination in the space-charge region or through surface states around the periphery or heterojunctions, self-absorption and re-emission of luminescence, voltage dependence of the barrier capacitance, stray capacitance and leakage. Steady-state amplitude-frequency and phase-frequency characteristics as well as the transient are calculated for both alternating-voltage and constant-voltage equivalent generators. Experiments were performed with five-layer structures containing a 0.4- $\mu\text{m}$  thick GaAs  $\langle 5 \cdot 10^{17} \text{ cm}^{-3} \text{ Si} \rangle$  active p-type layer with 0-5% AlAs, also an  $\text{Al}_{0.3}\text{Ga}_{0.7}\text{As} \langle 10^{18} \text{ cm}^{-3} \text{ Te} \rangle$  N-type emitter and an  $\text{Al}_{0.3}\text{Ga}_{0.7}\text{As} \langle 5 \cdot 10^{18} \text{ cm}^{-3} \text{ Ge} \rangle$  P-type emitter, their laser threshold currents within the 110-160 mA range. They were tested at currents not exceeding 18% of the threshold current so as to ensure negligible stimulated transitions and dominance of electric characteristics over optical ones. Measurements were made with a constant light signal, requiring only plain rather than high-speed photomultipliers. The results indicate that the time constant of the transient process is equal neither to the effective steady-state lifetime of excess charge carriers nor to the space-charge lifetime in the active layer. Figures 7; references 11: 7 Russian; 4 Western (1 in Russian translation). [279-2415]

UDC 535.863:666.189.2

#### FIBER-OPTIC OBSERVATION SYSTEM WITH IMAGE MOVEMENT

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 84  
(manuscript received 18 May 83) pp 9-11

MIKHEYEV, P. A. and YERSHOV, A. V.

[Abstract] It is demonstrated experimentally that the resolution of fiber optic systems can be nearly doubled by slow scanning of the image of objects over the end of the fiber optic part. The optimum angular velocity and amplitude of movement of the image in the ocular field of view for which the resolution of the system will be maximum can be found, depending upon the operating conditions of the device and its optical characteristics. The findings can be extended to a large class of systems in which the image is indicated with the help of mosaic elements, i.e., devices which digitize the image. Figures 4; references 14: 9 Russian; 5 Western (in Russian translation). [283-6900]

UDC 778.38+681.7.067.2+535.317

#### LENS FOR RECORDING THREE-DIMENSIONAL ENSEMBLES OF SMALL PARTICLES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 84  
(manuscript received 16 Mar 83) pp 25-26

KLIOT-DASHINSKAYA, I. M., SAMSONOVA, N. V., STASEL'KO, D. I. and CHURAYEV, A. L.

[Abstract] A high resolution lens for recording holograms of ensembles of small particles is developed in order to improve the quality of reconstructed

images of particles for cases in which the investigating ensembles, such as heated or fast-moving streams of particles, cannot be brought into contact with the hologram. An afocal optical system is described which keeps the magnification constant. The optical circuit and constructions of the lens make it possible to increase the contrast of the particle images when recorded and reconstructed by broad beams of light. This is by virtue of the possibility of placing an opaque screen in the common focal plane of the components of the lens in order to eliminate the light passing through the ensemble. Figures 2; references 5: 4 Russian, 1 Western.  
[283-6900]

#### INFLUENCE OF RESIDUAL STRESSES ON VACUUM TIGHTNESS OF ASSEMBLIES INCORPORATING FIBER-OPTIC PLATES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 84  
(manuscript received 22 Jun 83) pp 31-32

AFANAS'YEV, V. V., BALYASNYI, L. M., MECHETIN, A. M., LAZAREV, M. D. and LIBENSON, B. S.

[Abstract] A modification of the "Newton ring" method of measuring surface curvature is proposed in order to permit measurement of residual coefficient stresses, which depend upon the ratio of the temperature coefficients of linear expansion of the materials employed. A method is developed for rejecting assemblies with a maximally stressed fiber optic plate-adhesive-metal system, whose use makes it possible to conserve expensive parts and to perform input checking of materials. Figures 2; references 7: 5 Russian; 2 Western in Russian translation.  
[283-6900]

UDC 621.315.391.592

MULTIFREQUENCY DIFFRACTION OF LIGHT BY ULTRASOUND

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 3, Mar 84 (manuscript received 1 Jun 82, revised 12 Jul 83) pp 332-340

PETRUN'KIN, V. Yu. and VODOVATOV, I. A., Leningrad Polytechnical Institute

[Abstract] Multifrequency diffraction of light by ultrasound is examined on the basis of solving the integral equation obtained by expanding the slant field with respect to plane waves. The form of the solution obtained makes possible a deterministic as well as a statistical approach to estimating the nonlinear effects of multifrequency diffraction. The analytical expressions obtained for fundamental and combination signals are suitable over a wide range of variation in the index of modulation and diffraction parameter and for different ratios of the amplitude of the primary signal to the amplitude of other signals. The data obtained make it possible to define the dynamic range of acoustooptical devices operating in different diffraction modes with different numbers of signals. Figures 5; references 6: 4 Russian; 2 Western (1 in Russian translation).  
[204-6900]

UDC 537.226.33

DOMAIN DEVICES FOR ANALOG PROCESSING OF SIGNALS

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA in Russian Vol 48, No 6, Jun 84 pp 1094-1098

ALEKSEYEV, A. N., Moscow Institute of Engineering Physics

[Abstract] In addition to logic and memory devices based on cylindrical or plane magnetic domains for digital technology, much progress has also been made in development of devices based on domains and volume or surface acoustic waves for analog processing of signals. These devices usually consist of passive acoustoelectronic components, controllable and adaptive, assembled into structures of polydomain elastoferroelectric single crystals such as rare-earth molybdates or piezoferroelectric single crystals such as lithium niobate. Among the most original analog devices already developed are

magnetically or electrically controlled delay lines and bandpass or band-elimination filters. Other domain devices of this kind, for analog processing of optical signals, are discretely tunable diffraction gratings and transducers using volume or surface acoustic waves. Figures 3; references 14: 8 Russian; 6 Western.  
[286-2415]

UDC 537.226.33

# REFLECTION AND REFRACTION OF SOUND WAVES BY DOMAIN WALLS IN FERROELECTRIC CRYSTALS

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA in Russian Vol 48, No 6, Jun 84 pp 1168-1174

KESSENIKH, G. G. and SHUVALOV, L. A., Institute of Crystallography imeni A. V. Shubnikov, USSR Academy of Sciences

[Abstract] Reflection and refraction of sound waves by domain walls in ferroelectric crystals is analyzed, considering that the thickness of a domain wall remains much smaller than the wavelength over a wide frequency range. The problem is formulated in the quasi-static approximation without free electric charges:  $\text{div } D = 0$  and  $E = -\text{grad } \phi$  ( $D_i k_i = 0$  and  $E_i = -k_i \phi$  for plane monochromatic waves) with  $D_i \neq 0$  and  $E_i \neq 0$  generally but  $D_i = 0$  or  $E_i = 0$  in special cases depending on the crystal symmetry. Incidence of a sound wave on the boundary between two anisotropic media at an arbitrary angle produces three reflected and three reflected waves when the media are not piezoelectric, but in a piezoelectric medium there is also an electrostatic wave in addition to three sound waves. The corresponding system of three equations for elastic waves and Laplace equation for an electrostatic wave are solved for appropriate mechanical and electrical boundary conditions, considering the orientation of a domain wall relative to the planes of symmetry and to a plane perpendicular to the axis of an even-order symmetry. From the standpoint of reflection, neighboring domains differ either in their elastic constants or in the sign of their piezoelectric constants. The reflection coefficient is calculated for both kinds of domain walls, for longitudinal waves and for transverse waves as well as quasi-longitudinal and quasi-transverse ones in those planes. First a domain wall is assumed to be infinitesimally thin and then a correction is made for its finite thickness, but movement of domain walls by sound waves is disregarded. Figures 3; tables 2; references 13: 11 Russian; 2 Western (1 in Russian translation).  
[285-2415]

UDC [62-83:629.113.6].001.57

MATHEMATICAL MODEL FOR STUDY OF ELECTRIC TRACTION SYSTEMS FOR ELECTRIC VEHICLE

Moscow ELEKTRICHESTVO in Russian No 3, Mar 84 (manuscript received 30 May 83)  
pp 30-36

YEFREMOV, I. S., doctor of technical sciences, ANDREYEV, Yu. M., candidate of technical sciences, and LISTVINSKIY, M. S., candidate of technical sciences, Moscow

[Abstract] The main three problems in building an electric vehicle are devising most efficient new electric traction systems, evaluation and modernization of existing electric traction systems, and standardization for use of commercially produced components. The basic criteria of suitability are torque-speed characteristics, efficiency of energy conversion, reliability level, and resulting technical performance and economy. Feasibility and development study by computer simulation is the most expedient approach to solution of those and related problems. A mathematical model for this purpose is the EM-STEP-RUD ("elektromobil' - sistema tyagovogo elektroprivoda elektromobilya - rezhim i usloviya ego dvizheniya" [electric car --electric traction system for electric car--driving mode and conditions]). It describes by a digital computer the motion of a car along any route in an velocity mode and the performance of its electric traction system during changes in electrical, thermal, and energy parameters of the battery-motor-generator set. Each component is represented by its characteristics, essentially current-voltage, torque-speed, torque-current characteristics as well as temperature-load-time characteristics. Calculations based on this model have been programmed so as also to yield and the capabilities of the vehicle in commercial terms such as range, passenger capacity, economy, and controls. The mathematical model has been verified experimentally and the error is found not to exceed 8%. The electric traction system in BelAz-549 trucks of 75 ton capacity, to be used in trucks of 110-120 ton capacity, and the electric traction system in LAZ-699E electric buses (battery only) or in LAZ-5252E hybrid buses have been analyzed and evaluated according to this model. Figures 4; references: 2 Russian.  
[280-2415]

'INTERELEKTRO' - ACHIEVEMENTS AND OUTLOOK

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 83 pp 2-5

KLESHCHEV, V. V., candidate of technical sciences, chief, Secretariat of "Interelektro"

[Abstract] "Interelektro" was established in 1973 by the governments of Bulgaria, Czechoslovakia, Hungary, East Germany, Poland, Romania, the Soviet Union, and (since 1975) Yugoslavia for economic, scientific and technical cooperation in electrical equipment manufacture. The main objective has been to meet the demands of each participating country for high-quality products through pooling of resources and division of labor in a most mutually satisfactory manner. This was achieved on the basis of multilateral specialization and cooperation. The implementation of 20 treaties in effect since 1977 pertaining to scientific-engineering effort and of 12 treaties in effect since 1981 pertaining to production has already substantially reduced deficiencies in the electrical industries of these countries. Programs already completed are commercial production of new large (up to 1000 kW) high-voltage induction motors, fractional kW single-phase induction motors, laminated dielectrics for printed-circuit boards, flexible insulation materials, lamps, light sources, semiconductor power devices, and high-voltage (110-220 kV) cables with plastic insulation. Programs undergoing completion include production of standard low-voltage induction motors, explosion-proof and mining motors, automatic 10-1600 A circuit breakers, large (up to 1600 kVA, 22 kV) power distribution transformers, and 6/35 kV distribution equipment with oilless and vacuum switches. A major concern of "Interelektro" is efficient and economical use of materials, especially precious and scarce ones. Typically, plastics and synthetics are replacing cotton cloth and glass as insulation materials, silver and tungsten content in electrical contacts is being reduced, high-pressure gas-discharge tubes are being built for lighting, and the capability of low-voltage automatic switches has been increased from 25.5 A/dm<sup>3</sup> and 26.9 A/kg to 61 A/dm<sup>3</sup> and 58 A/kg. Other important activities of "Interelektro" are short-range and long-range standardization, 89 CEMA Standards being added during the current 1984-85 year. This is accompanied by coordination of planning, forecasting, and capital investment, joint research and new product development, as well as expanding automation with more extensive use of microcomputers and microprocessors.

[162-2415]



## STANDARDIZATION OF 'INTERELEKTRO' SPECIAL-PURPOSE PRODUCTS

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 83 pp 6-7

NEMTSEV, G. G., engineer, and FOMIN, V. M., candidate of technical sciences

[Abstract] The process of standardizing "Interelektro" product lines began with the very existence of this organization in 1973, within the framework of the overall standardization program. The present phase of the process is developing technical norms and specifications for all electrical product lines through coordination of scientific-engineering effort in the member countries, as well as on the basis of multilateral agreements pertaining to specialization and cooperation. At the present time there are 288 CEMA Standards in effect, 139 having been introduced by "Interelektro". They cover basic product lines, products and parts deliveries, individual quality requirements, performance parameters, dimensions for mounting and hookup, test and inspection procedures. About one third of these Standards have been developed in the USSR, with due consideration of national Soviet and leading foreign or international Standards (ISO, IEC). Further activity will focus on developing a programmed target-oriented method of long-range standardization, including lists of specific Standards with relevant documentation in existing and negotiated agreements, integrating all development of Standards for electrical equipment within "Interelektro" without interference from other CEMA agencies, and interfacing "Interelektro" with international agencies (ISO, IEC) on matters of standardization.

[162-2415]

## AUTOMATED INTERNATIONAL CENTER OF SCIENTIFIC-TECHNICAL INFORMATION FOR ELECTRICAL INDUSTRY

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 83 pp 7-9

KOVALEV, F. S., candidate of economic sciences

[Abstract] The automated international center of scientific-technical information for the electrical industry set up by "Interelektro" is an example of cooperative effort by CEMA countries and a step in an overall program of industrial integration. It is essentially a network of computers interlinked by communication channels so as to form a single complex, operating with special formal data-search languages, and capable of reading and analyzing texts with subsequent interpretation in the machine language or of translating from one natural language to another. Its two automated basic subsystems are documentation and data presentation. The main data bank is located at the headquarters and can be duplicated in each national member bank. Users are serviced, either in the selective data distribution mode over a definite interrogation period, or in the dialog mode with a definite scannable segment of the facility. The

principal users are enterprises and institutions in member countries engaged in electric equipment engineering and manufacture. Bulgarian and East German specialists have developed the data transfer onto carriers for machine readout. Czechoslovak specialists have developed the data storage. Present under-utilization of the center is attributable partly to imperfect service and partly to excessive complexity of problems at hand. These deficiencies must be remedied, principally at the source--the document. The latter must become more functional and specialist-oriented, especially when relating to electrical machines. Eventually this automated international information center will become one of the most important and even indispensable resource for science, engineering and industry.

[162-2415]

UDC 621.3.001.8(103)

#### ACTIVITIES AT BERLIN HIGH-POWER TESTING LABORATORY WITHIN 'INTERELEKTROTEST' ORGANIZATION

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 83 pp 47-49

HENISCH, H., doctor of engineering, and BUCHOLD, E., certified engineer, GDR

[Abstract] The activities of high-power and high-voltage testing laboratories in the CEMA countries Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Romania and USSR as well as Yugoslavia have been coordinated in 1973 under the "Interelektrotest" umbrella organization, which is closely associated with the "Interelektro" Group 2. The objectives of this organization are development of scientific-technical coordination in the field of testing and measurements, standardization of test requirements and instrumentation, standardization of data processing and equipment certification procedures, exchange of information and facilities, mutual assistance and consultation in problem solving, specialization and cooperation, and common interpretation of documents issued by worldwide international organizations (IEC, SIGRE). It is also concerned with CEMA standards, mechanical and climatic testing, and automation of measurements. "Interelektrotest" embraces 18 high-power and 19 high-voltage laboratories in member countries. The leading high-power laboratory is located in Berlin, GDR. Here are tested 123-420 kV air circuit-breakers, 420 kV power transformers, 12-420 kV instrument transformers, full-load (up to 1000 A) voltage regulators for power transformers, and 12-123 kV collection-distribution boxes. In addition, this laboratory serves as a research resource center for the entire organization. Jointly with the "Transformatoren und Röntgen Werk" enterprise in Dresden and the Scientific Research Institute of Direct Current in Leningrad, this laboratory has developed a test stand for alternating voltages up to 1800 kV and switching pulses of up to 2500 kV amplitude, a generator of 5000 kV voltage pulses on an isolation tower, a test stand for superposing 1200 kV d.c. voltage pulses on 500 kV a.c. voltage to peak voltages up to 1600 kV, and a test data evaluation facility with computer. Projects now underway include development of switching equipment for currents up to 80(100) kA under superhigh voltage and of collection-distribution cells for 245(420) kV, broadening the scope of tests, especially the range of climatic conditions, and complete automation of tests with the aid of microcomputers from application of power to printout of records.

[162-2415]

## ESTIMATION OF PARAMETERS OF MULTIELEMENT MIRROR IN ADAPTIVE OPTICAL SYSTEMS

Moscow OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 3, Mar 84  
(manuscript received 5 Apr 83) pp 16-18

MALAKHOV, M. N., MATYUKIN, V. F. and PRILEPSKIY, B. V.

[Abstract] Determination of the setting tolerances for the elements of a composite mirror employed in an adaptive optical system is examined. A detailed analysis is made of the influence of setting errors of subapertures with different configurations on the value of the Strehl number. A general expression is derived for computing the mean Strehl number of a composite aperture. Incoherent combination of radiation from different subapertures is analyzed. The average Strehl number is computed as a function of the subaperture setting error for square and round subapertures, and the average Strehl number is found as a function of the number of elements. The Strehl number is found to be determined by the sum of two components: the Strehl number for an unphased aperture (incoherent combination) and an interference component. Figures 3; references 9: 6 Russian; 3 Western (2 in Russian translation).  
[261-6900]

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## INVESTIGATION OF PHOTOLITHOGRAPHIC METHODS OF FABRICATING PHASE DIFFRACTION GRATINGS

Moscow OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 3, Mar 84  
(manuscript received 20 Jun 83) pp 23-26

MIROSHIN, A. A., OVCHARENKO, O. I. and OSOVITSKIY, A. N.

[Abstract] Some photolithographic methods for fabricating small diffraction gratings employing holographic exposure in preparing the photoresistive mask of the grating, followed by ion or plasma chemical etching, are examined. Methods are considered by which masks can be obtained that completely cover the surface of the substrate except for the grating region. The use of thermal duplication, applying a protective coating to a photoresist relief and chemical fixation are described. Photolithography employing holographic exposure is shown to be useful for producing diffraction gratings with limited dimensions. Both methods for keeping diffraction gratings within the required contour provide uniform parameters and sharp boundaries. Figures 3; references 5: 3 Russian; 2 Russian (1 in Russian translation).  
[261-6900]

# INVESTIGATION OF TEMPERATURE CONDITIONS OF VACUUM SYSTEM TURRET DURING APPLICATION OF OPTICAL COATINGS

Moscow OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 3, Mar 84  
(manuscript received 25 Feb 83) pp 26-28

PANTELEYEV, G. V., MORSHAKOV, V. V., YAMPOL'SKIY, V. I. and YEGOROV, V. N.

[Abstract] The vacuum chamber of a deposition system with a shielded thermal heater placed above the rotating turret is examined. The turret is a hollow portion of a sphere fitted to hold optical elements by means of three long metal posts. A heat balance equation is derived which describes the behavior of the turret temperature as a function of the time elapsed from the point at which the heater is activated. A second equation is derived for the cooling of the turret. Analysis of the equations shows that the temperature behavior can be completely controlled by measuring a maximum temperature as a function of the current passing through the heater and the temperature of the turret as a function of time as the device heats or cools. Figures 3; references 4: 2 Russian; 2 Western.  
[261-6900]

# PROSPECTS FOR DEVELOPMENT OF OPTICAL INSTRUMENT ENGINEERING FOR MACHINE BUILDING IN PEOPLE'S REPUBLIC OF BULGARIA

Moscow OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 3, Mar 84  
pp 32-34

STOILOV, S.

[Abstract] Work is under way along many fronts in order to further optical instrument engineering in the People's Republic of Bulgaria. Major emphasis has been placed on the development of computational optics, on designing optical systems and creating a component base, technology and means of automation for optical production. New optical materials are being put into use by other branches of industry. Assistance from the USSR, Hungary, the German Democratic Republic and the Polish People's Republic is cited. The primary task to be resolved during the Eighth Five-Year-Plan is to provide further scientific servicing and support for the fulfillment of the branch production program by organizing effective scientific research and experimental production activity and implementing the achievements of optical science and engineering in production. The development of an experimental machine for grinding and polishing optical components is outlined. Development in the area of projection optics is discussed.  
[261-6900]

## INVESTIGATION OF ULTRASONIC SEPARATION OF OPTICAL PARTS

Moscow OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 3, Mar 84  
(manuscript received 26 Apr 83) pp 46-49

SHUMILOV, Yu. P. and STEPANENKO, A. V.

[Abstract] An ultrasonic method is described for separating finished optical parts from the matrix to which they are glued by using longitudinal and radio oscillations. A closed oscillating system for delivering ultrasound to the matrix is employed. The system creates a longitudinal standing ultrasonic wave at the point of contact of the closed acoustic system formed by the transducer, the waveguide, the matrix, the adhesive and the blank, which causes the adhesive composition to crack and allows the optical parts to be separated from the matrix. Tests on a commercially produced UZR-2 installation showed outputs exceeding that of existing separation methods by factors of 7-12, with practically no rejects. The savings provided by a single system comprise about 50,000 rubles annually. Figures 3; references: 6 Russian. [261-6900]

## A "FIND THE MINE" GAME

Moscow RADIO in Russian No 5, May 84 pp 49-50

KHAYKIN, B., Simferopol

[Abstract] A home-built electronic game is described in which a "mine", consisting of a relaxation oscillator which produces short pulses, is concealed beneath the top of a box bearing a simulated terrain map. The object of the game is to find the "mine" by tracing the surface of the map with a probe connected to an audio amplifier, such as a tape recorder, until the "mine" is found, which is signified by an audible signal. Schematic and circuit board diagrams of the "mine" and probe are presented. The game can be made more interesting by placing several "mines" within the box. Figures 3. [245-6900]

CSO: 1860

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